

Legislative Audit Division

State of Montana



Report to the Legislature

November 2006

Performance Audit

Montana University System Research and Development

The Board of Regents of the Montana University System
The Office of the Commissioner of Higher Education
Montana State University – Bozeman
The University of Montana – Missoula
Montana Tech of The University of Montana – Butte

This report contains findings and recommendations developed as a result of a performance audit of research and development functions in the Montana University System. Findings and recommendations address:

- ▶ Reporting research activities at MUS universities.
- ▶ The role of the Board of Regents in relation to congressional earmark funding for universities.
- ▶ University use of information systems.
- ▶ Specialization of staff functions in sponsored programs offices.
- ▶ Training provisions for university faculty.
- ▶ Areas for improvement in the future management of technology transfer functions.

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November 2006

The Legislative Audit Committee
of the Montana State Legislature:

This is our performance audit of Research and Development in the Montana University System. This report includes background information on research and development activities within the three main research universities within the system. Report recommendations address research funding issues, administration of sponsored research, and management of technology transfer functions. Written responses from the Office of the Commissioner of Higher Education, The University of Montana, and Montana State University are included at the end of the report.

We wish to express our appreciation to all MUS staff and others for their cooperation and assistance during the audit.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Scott A. Seacat", with a long horizontal flourish extending to the right.

Scott A. Seacat
Legislative Auditor

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Legislative Audit Division

Performance Audit

Montana University System Research and Development

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Montana State University – Bozeman

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Members of the audit staff involved in this audit were Angus Maciver
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Appointed and Administrative Officials

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Montana State University	Dr. Geoffrey Gamble, President Dr. Thomas McCoy, Vice President for Research, Creativity, and Technology Transfer
Montana Tech of The University of Montana	Dr. Frank Gilmore, Chancellor Dr. Joseph Figueira, Associate Vice Chancellor for Research, Graduate Studies, and International Programs
Office of the Commissioner of Higher Education	Sheila Stearns, Commissioner of Higher Education Dave Gibson, Associate Commissioner for Research, Technology, and Communications
Montana Board of Regents of Higher Education	Lynn Morrison-Hamilton, Chair Stephen M. Barrett, Vice Chair Clayton Christian Dr. Janine Pease Mark Semmens Lila Taylor Heather O'Loughlin, Student Regent Brian Schweitzer, Governor* Linda McCulloch, Superintendent of Public Instruction* Sheila Stearns, Ed.D., Commissioner of Higher Education *

*Ex-officio member

Introduction

A performance audit of management of research and development within the MUS was prioritized by the Legislative Audit Committee for the 2005 biennium. Our audit work addressed the policies and procedures adopted by the Montana Universities in relation to R&D, assessed the effectiveness of research administration, evaluated the security of intellectual property assets, reviewed the economic benefits of these activities, and compared the management within the MUS with peer institutions around the nation. Our audit assessed R&D activities at the three main MUS research universities; MSU, UM, and Montana Tech of The University of Montana.

Research and Development Activities

Universities conduct a substantial portion of the nation's research. Research and development (R&D) is the process of conducting research and identifying practical applications for the results. The research process at MUS universities consists of both research and technology transfer activities. Technology transfer refers to the process of converting findings from academic research into products, processes, or ideas useful commercially. Increasingly, universities are recognizing the economic benefits of commercializing research through the process of technology transfer.

The level of research funding for the MUS has been increasing steadily over the past decade. MSU more than doubled its research expenditures from \$38.7 million in 1996 to \$98.5 in 2005 and UM almost tripled its research expenditures from \$22.0 million in 1996 to \$61.6 in 2005. Montana Tech research expenditures have grown from \$3.5 million in 1996 to \$7.0 in 2005. In the last ten years, as a system, MUS research activity more than doubled from \$64.2 in 1996 to \$167.1 in 2005.

Audit Issues Identified During Review of Research Activities

Overall, audit findings show MUS universities are adapting to handle the growing volumes of funding for research and related technology transfer activities. The state's university system has become increasingly competitive at the national level in terms of attracting funding for research. MUS universities have also become more active in their approach to technology transfer and have shown an increasing awareness of the commercial potential inherent in R&D

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activities. However, we believe the Montana University System could make improvements to fully meet the potential of its research and development efforts. These areas for improvement relate primarily to the administration of research, the effectiveness of technology transfer functions, and the role of the Board of Regents in university R&D activities.

Ensure Consistent Reporting of Research Data on Campuses

Consistency in the types of data reported and the compilation methods used is important for governing entities such as the BOR. During our review we identified universities are using different types of measurements or quantifying data in different ways. This makes it difficult for BOR to provide effective oversight of research activities. As the overall level of funding for research increases, the university system faces more demands for consistent reporting on these activities. To discharge its responsibility fully, the board should require relevant and consistent reporting on research activities from all campuses.

Coordinate Use of Information Systems

Universities with large volumes of research funding increasingly rely on information systems to manage workload associated with grants/contracts and provide accurate reports on these activities. Our review of procedures in research offices showed MUS universities vary in the way information systems are used. Coordination of the information systems provides benefits. Those benefits include elimination of costs associated with maintaining a duplicate system and improved securing and stability offered by an enterprise system. The BOR through the Office of the Commissioner of Higher Education should coordinate these efforts in different component units of the university system.

UM-Missoula Assign Pre-Award Staff by Departmental Specialization

The UM Grant Accounting Office (Post-award functions) assigns its staff to specific departments for grant administration and management. This allows the staff members to become familiar with PIs within the department and also, the departmental policies and procedures. However, OSP staff (pre-award functions) at UM are not assigned to specific departments within the university, but may work on various departments' proposals and budgets. As the volume of research has grown over the years, the importance of specialized

knowledge has also increased. By moving towards departmental specialization in the OSP, UM could ensure a greater level of consistency in its own administration of sponsored programs, and between other MUS and peer universities.

Implement Mandatory Training Addressing Core Elements of Research and Additional Training Opportunities

MUS universities offer research training sessions to PIs. However, faculty and staff are presented with large volumes of information on diverse topics, some of which may not be immediately relevant to their role in research programs. Training in issues relating to research is important because PIs are responsible for many aspects of grant administration and federal agencies' policies and procedures are becoming more comprehensive than in the past.

We identified two areas of concern relative to PI training programs at MUS universities. Attendance at training has not been made mandatory across all units of the system. The current training model may be too broad in nature and may not serve specific needs of different research faculty. In developing training courses for both the mandatory and optional elements, MUS universities could work cooperatively to define content, while also ensuring a degree of consistency in training provisions across the system.

Montana Board of Regents Address Its Role in the Process of Direct Congressional Appropriations

When universities apply for federal research grants and contracts, they compete against various universities around the nation. The peer review process ensures research proposals are funded based on merit as determined by expert and knowledgeable reviewers. Earmark requests do not compete against multiple universities around the nation nor are they subject to a peer review process. This does not mean earmark requests have no merit, but it does mean these proposals are judged on a different basis from most other externally-funded research in Montana's universities.

While earmarks are beneficial in terms of research resources and infrastructure, they do not receive the review or the competition of other research proposals. Recent growth in earmark funding should emphasize the importance of understanding these funding proposals by administrators of the university system. The involvement of the

Report Summary

Board of Regents in reviewing and understanding earmark proposals would provide additional opportunities to assess the viability and suitability of different proposals.

Montana Board of Regents Revise Timeframes for Policy Number 401.2

Policy 401.2 states once a PI supplies the TTO with an invention disclosure, the office has 60 days to conduct a preliminary patent search or release the discovery to the PI. It also states the office has eight months to file a patent following a disclosure. Our review of MUS technology transfer activities shows the current timeframes established in BOR policy are not consistent with actual practice. Where these timeframes are based on the actual experiences of universities, they should serve as a more reliable means of assessing the timeliness of the technology transfer process.

Review Methodologies for Capitalizing Intellectual Property as Intangible Assets

Intellectual property (IP) assets held by units of the university system have the potential to deliver significant revenues to universities through licensing agreements and other forms of commercial development. Misstatements in financial reporting are less likely where there is an established and standardized methodology for capitalizing these assets. The Office of the Commissioner of Higher Education should work with universities to review and refine methodologies for capitalizing IP as intangible assets.

Ensure Technology Transfer Issues Receive Sufficient Emphasis in Training

MUS universities are responsible for ensuring faculty and staff performing federally-funded research have at least an awareness of their responsibilities under applicable federal laws. Survey responses showed generally low levels of awareness among MUS faculty and staff of technology transfer functions and issues relating to IP. Regardless of the level of interest shown by faculty and staff relative to technology transfer, these issues need to be directly and specifically addressed in mandatory training sessions. In addition, university technology transfer functions should develop in-depth training content in this area and make efforts to publicize these training opportunities and promote attendance.

Montana Board of Regents Develop a System-wide Approach to Technology Transfer Issues

Individual units have not been required to develop objective and comparable means of measuring their successes in the area of technology transfer. Currently, Montana lacks a comprehensive and consistent means of quantifying technology transfer activities across all the units of the MUS. Improvements are needed in the ability of the MUS to plan strategically for technology transfer activities and assess its progress in meeting established goals for all component units.

These improvements should involve the requirement that universities incorporate the prioritization of technology transfer activities in their strategic planning or similar long-range planning initiatives. The BOR should also work with universities to develop standardized, objective criteria for measuring progress in meeting technology transfer goals.

Chapter I - Introduction

Introduction

Universities conduct a substantial portion of the nation's research. Research and development (R&D) is the process of conducting research and identifying practical applications for the results. Universities can submit research proposals and receive funds from various sources, including state and federal agencies, non-profit organizations, private companies, and other universities. Research activities funded through external sources is generally referred to as sponsored research.

The majority of sponsored research conducted at universities is in the form of basic research, as compared to applied research. Basic research is aimed at gaining a more comprehensive knowledge or understanding of the subject under study without specific applications in mind. Applied research enhances and adapts existing scientific knowledge and technology, and can lead to technology transfer. Technology transfer refers to the process of converting findings from academic research into products, processes, or ideas useful commercially. Increasingly, universities are recognizing the economic benefits of commercializing research through the process of technology transfer.

Growth in Research Funding for Montana Universities

Research within the nation's universities has grown considerably in recent years, fueled to a large degree by increased research funding from the federal government. Growth at the national level has been reflected in increasing volumes of research funding for universities, including those in Montana. For all units of the Montana University System (MUS), research expenditures almost doubled from \$74 million in 1996 to \$141 million in 2003.

MUS Universities' Research Offices

The research process at MUS universities consists of both research and technology transfer activities. At Montana State University (MSU) Bozeman, the Office of the Vice President for Research, Creativity, and Technology Transfer (RCTT) administers all grants and contracts for research and creative projects at the university. The office also serves as the technology transfer arm of the university. Research expenditures at MSU-Bozeman have increased

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from \$61 million in 2000 to \$98 million in 2005. At The University of Montana (UM) Missoula, the Office of the Vice President for Research and Development (VPRD) is responsible for university externally-generated grants and contracts. The office also works with researchers to commercialize research through a technology transfer office. UM-Missoula research expenditures have grown from \$31.5 million in 2000 to \$61.6 million in 2005.

Audit Objectives and Scope

A performance audit of management of research and development within the MUS was prioritized by the Legislative Audit Committee for the 2005 biennium. Our audit work addressed the policies and procedures adopted by Montana universities in relation to R&D, assessed the effectiveness of research administration, evaluated the security of intellectual property assets, reviewed the economic benefits of these activities, and compared the management within the MUS with peer institutions around the nation.

We developed the following three main audit objectives.

- ▶ Determine whether the MUS manages R&D resources and funding effectively.
- ▶ Determine if MUS has an efficient and effective process for protecting and commercializing services, products, or creative works created through R&D.
- ▶ Determine the impact of MUS R&D and technology transfer activities on the state's economy.

Our audit assessed R&D activities at the three main MUS research universities; MSU, UM, and Montana Tech of The University of Montana (Tech). Montana's community colleges, as well as other four-year universities reported fewer than five million dollars in expenditures for FY 2005 and were excluded from audit scope. Unless otherwise stated, analysis of R&D activities addresses FY 1996 through FY 2005. This timeframe was established to ensure sufficient historical data was available to identify trends in program activities.

File reviews were conducted in the research and technology transfer offices to review documentation procedures and assess compliance with applicable laws, regulations, policies and procedures. We also conducted an extensive survey of MUS faculty members to identify any concerns or issues regarding R&D activities at their university.

Appendices provide further information regarding audit scope and methodologies used for evaluating MUS R&D activities.

Audit Findings Relating to R & D Activities

Overall, audit findings show MUS universities are adapting to handle the growing volumes of funding for research and related technology transfer activities. The state's university system has become increasingly competitive at the national level in terms of attracting funding for research. MUS universities have also become more active in their approach to technology transfer and have shown an increasing awareness of the commercial potential inherent in R&D activities. However, we believe the Montana University System could make improvements to fully meet the potential of its research and development efforts. Areas for improvement relate primarily to the administration of research, the effectiveness of technology transfer functions, and the role of the Board of Regents in university R&D activities.

Chapter II – Background

Introduction

This chapter outlines basic background information relating to federal and state laws, the role of the Board of Regents (BOR) in R&D activities, the mission and objectives of the MUS relative to R&D, and the organization and staffing of MUS universities' research offices. Also included in this chapter is a narrative description of the R&D process.

Emphasis on University Research

Federal and state laws emphasize R&D. The following sections discuss changes in federal and state law and BOR and university policy in relation to R&D.

Sponsored Research Process

Sponsored research refers to those activities within universities where external agencies or organizations fund academic research activities. For the purpose of this report sponsored programs and research are used interchangeably. The most common form of funding for sponsored research is grant-based and the most common funding sources are federal government agencies. Other funding sources include state government, private companies, nonprofit institutions or organizations, and other institutions of higher education. Throughout this report we use the term grant to refer generically to UM grants, cooperative agreements and other awards funding sponsored research.

Federal Law and the Bayh-Dole Act

The most significant federal legislation affecting university R&D activities was the Bayh-Dole Act (P.L. 96-517). Congress passed Bayh-Dole in 1980, which allowed inventions created under federal contracts and grants to become the property of the contractors and grantees, provided certain reporting and other requirements are followed. The main purpose of Bayh-Dole was to allow universities, not-for-profit corporations, and small businesses to patent and commercialize their federally funded inventions. Before Bayh-Dole, federal agencies generally retained title to any inventions created under federal research.

Federal statute also addresses the role of federal agencies providing research funds to universities through grants and/or contracts. The

Chapter II – Background

Office of Management and Budget (OMB) issues instructions or information to federal agencies in the form of circulars. Two OMB circulars related to research administration are A-21 (Cost Principles for Educational Institutions) and A-110 (Uniform Administrative Requirements for Grants and Other Agreements with Institutions of Higher Education, Hospitals, and Other Non-Profit Organizations). All federal agencies are bound by the requirements of these circulars. In addition to these circulars, individual federal agencies have policies and procedures in place to administer their own individual grants and contracts.

State Law

Units of the MUS are authorized in section 20-25-108, MCA, to engage in various activities associated with R&D. These statutory provisions include the following statement relative to the research effort “The legislature declares a public need for scientific research in the units of the system to promote the general welfare and to provide an adequate defense for the United States.” In addition, section 20-25-109, MCA, specifically authorizes MUS employees to engage in commercialization activities associated with technology transfer projects.

During the 1989 legislative session, amendments to state law changed the distribution of indirect cost reimbursements. These amendments allowed MUS universities to keep indirect cost reimbursements associated with research grants. Indirect costs or facilities and administrative costs (F&A) refer to those costs that can not easily be billed to one research project. Examples of F&A costs include: building operation and maintenance, depreciation on equipment and facilities, and administrative overhead. These statutory provisions allow MUS universities to assist departments with resources for new research, research or academic facilities and libraries, new faculty recruitment, research administration, and equipment replacement.

Board of Regents Policy

The BOR has constitutional and statutory responsibility and authority to supervise, coordinate, and manage the MUS. The Regents and their staff within the Office of the Commissioner of

Higher Education (OCHE) have developed policies to manage the R&D process for MUS universities, including the following:

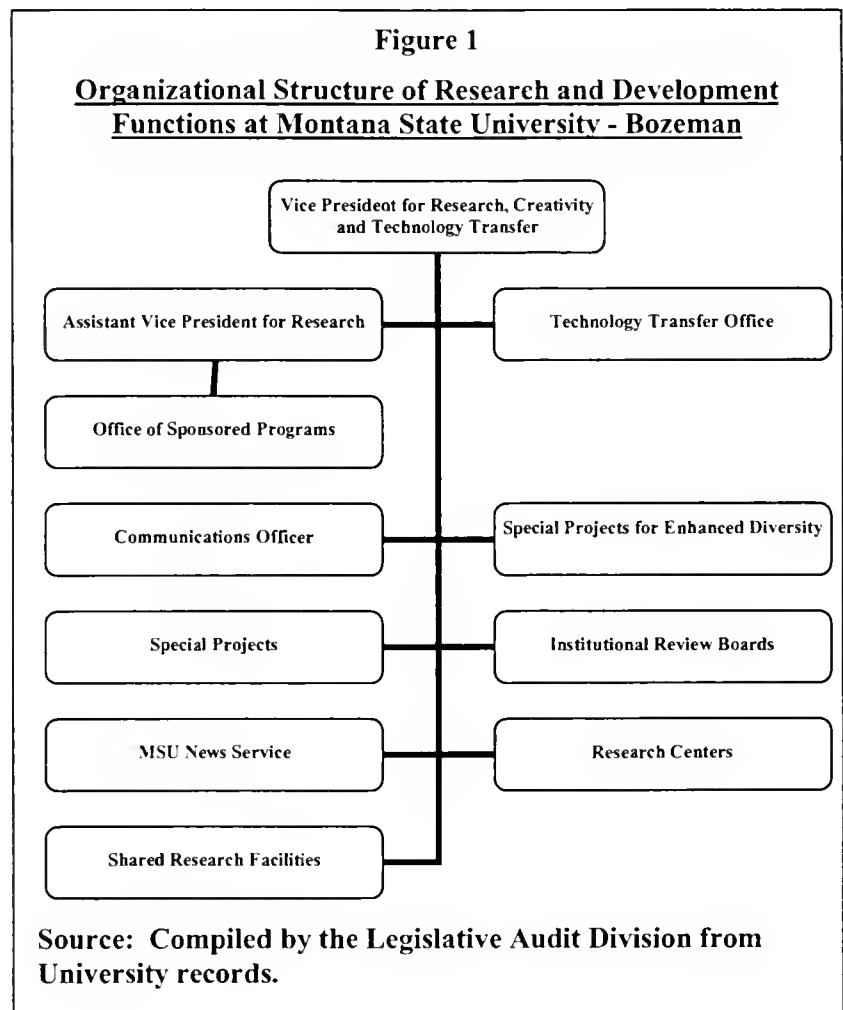
- ▶ Policy 401.2 addresses inventions and patents on MUS universities and allows intellectual property created by MUS employees to be disseminated and utilized in a fashion mutually advantageous to the state, MUS, the business entity, and the employee.
- ▶ Policy 403 addresses the need for inter-campus communication and coordination of R&D efforts within the MUS. This policy also establishes a requirement for university R&D programs to be logically related to the university's mission.
- ▶ Policy 407 implements the provision of Section 20-25-109, MCA, which requires the BOR to approve university system employee's ownership of equity interest in intellectual property belonging to the employee. The policy allows university employees, with board approval, to serve as board members, officers, or employees of a business entity that has an agreement with the university or shares an ownership interest in the intellectual property with the university.
- ▶ Policy 404 addresses the indirect cost recovery rate for units of the MUS.

University Policy

MUS universities have multiple policies and procedures related to R&D which will be discussed throughout this report. Both MSU and UM have acknowledged the importance of university R&D through their mission statements. MSU mission statement includes the language, "To provide an environment that promotes the exploration, discovery, and dissemination of new knowledge." UM mission states, "The University of Montana-Missoula provides basic and applied research, technology transfer, cultural outreach, and service benefiting the local community, region, state, nation, and the world."

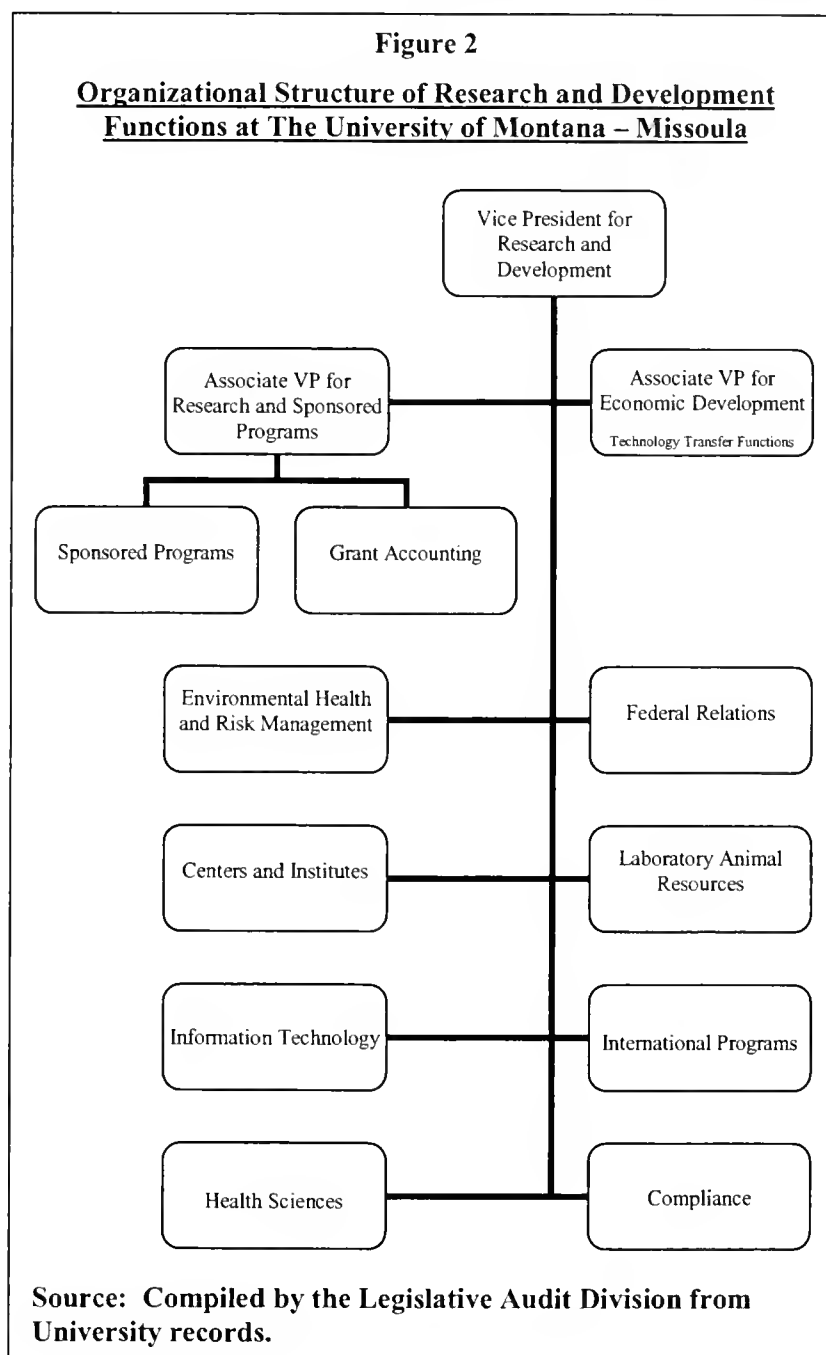
Organization and Staffing of MUS Research Offices

The two main research universities in Montana are MSU and UM. MSU organizational structure within the Office of the Vice President for Research, Creativity, and Technology Transfer (RCTT) is represented in Figure 1.



The Office of Sponsored Programs (OSP) manages all financial, reporting, compliance, and related tasks for research activity at MSU. The Technology Transfer Office (TTO) is responsible for managing intellectual property and moving technology into the private sector. Other administrative offices within the RCTT handle topics including research involving human subjects, research centers, media projects for MSU creative projects, and diversity.

UM organizational structure within the Vice President for Research and Development (VPRD) office is represented in Figure 2.



The UM Office of Research and Sponsored Programs (ORSP) is broken into two separate functions, Sponsored Programs and Grant Accounting. Sponsored Programs staff are responsible for pre-award functions including: processing proposals, administrative review and

Chapter II – Background

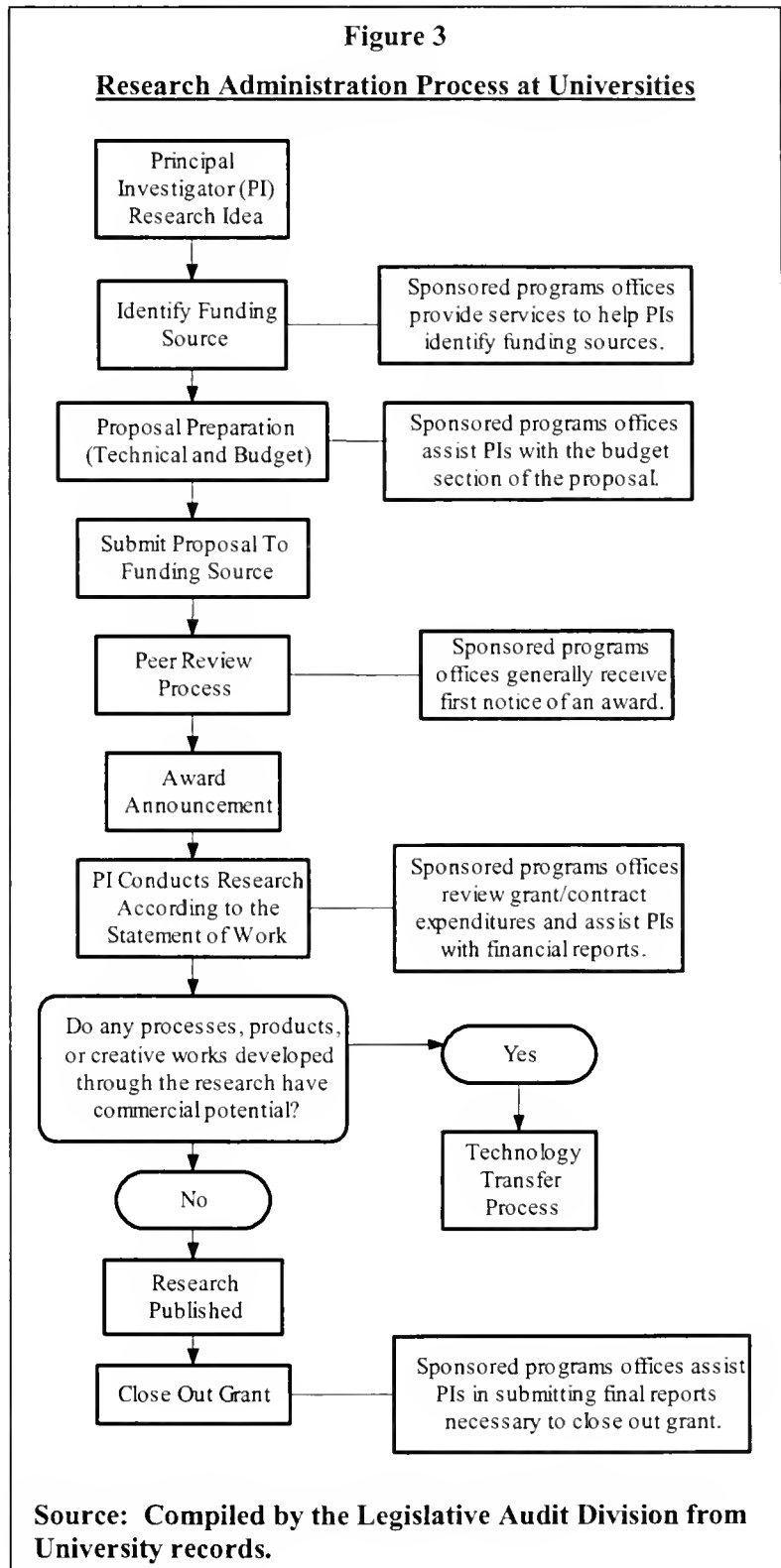
sign-off, assistance with research budgets, and negotiation of external agreements. Grant Accounting staff are responsible for oversight and financial management of research after the grant or contract has been awarded.

The Associate Vice President for Economic Development is the Director of the Technology Transfer Office (TTO). The function of the office is to aid Principal Investigators (PI), the faculty members responsible for the design and implementation of the research, in managing their innovative processes. Other administrative offices within the VPRD handle areas including environmental compliance, use of laboratory animal and human subjects in research, international programs, information technology, and federal relations.

Tech also has an Office of the Associate Vice Chancellor for Research, Graduate Studies, and International Programs. This office provides information on current research, proposal preparation, undergraduate research, and graduate research opportunities.

Research Administration

Research activities are generally funded by outside agencies or organizations either through a grant or contract. Grants are the most common form of funding. The process by which a PI obtains a grant or contract is illustrated in the following figure.



Chapter II – Background

Once a PI has identified a research topic and a source for funding, they must submit a proposal to the funding agency. The proposal usually will include both a technical section and a budget section. The technical section includes the statement of work and other information related to how the research will be conducted. The budget includes the cost elements needed to accomplish the proposed activities outlined in the technical section.

Once submitted the majority of proposals will go through a review process at the funding agency. This review consists of a panel of peer researchers who review whether the proposal is novel, meets research objectives, and whether the environment exists for the project to be a success, as well as other defined criteria. The investigator's qualifications are also reviewed to determine whether they are appropriately trained to carry out the research successfully.

If the PI's proposal is selected, typically the funding agency will notify the OSP, or similar office, regarding its decision. Many grant and contract agreements need to be negotiated before final acceptance; the OSP handles these negotiations. Once the grant or contract is accepted and a subsequent account is opened through the OSP, the PI receives access to this account and is able to expend research dollars in accordance with the approved statement of work and budget.

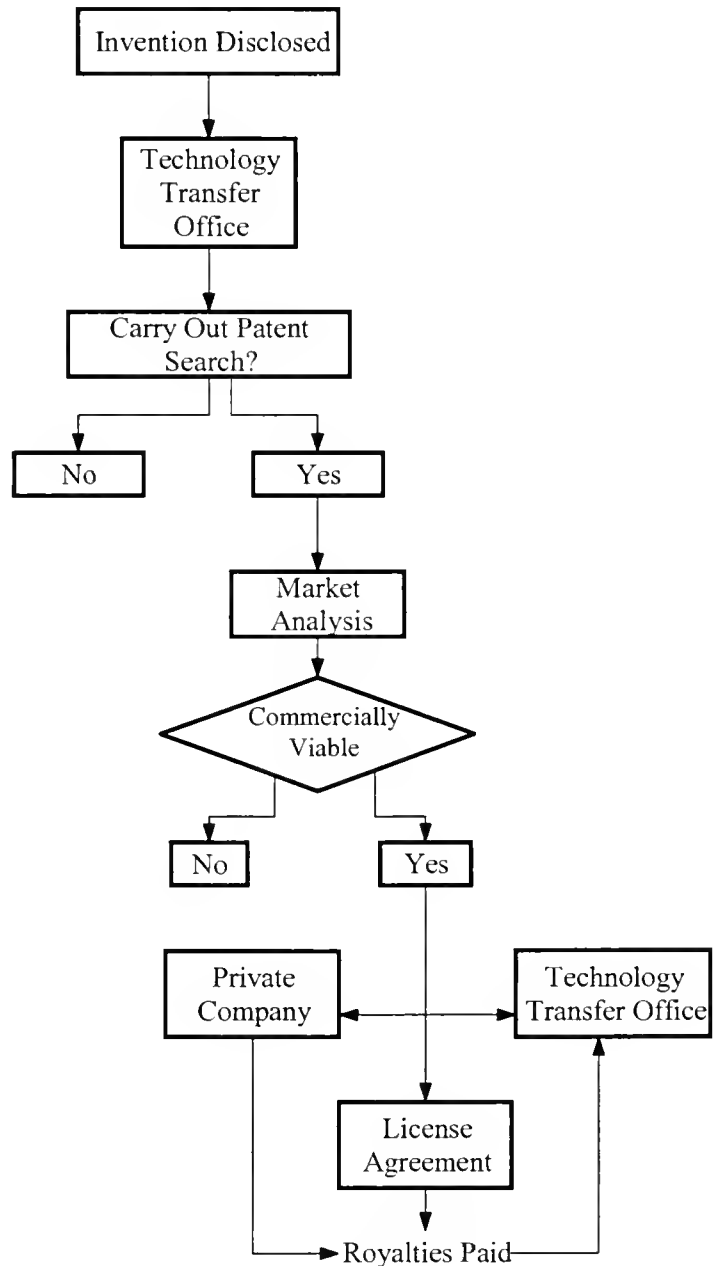
The majority of research does not have commercial value; however, PIs can disseminate their findings through conferences, seminars, and publications. If a PI creates or develops any processes, products, or creative works developed through their research that has commercial potential they are required to contact the Technology Transfer Office (TTO). The TTO will guide the PI through the technology transfer process. If no intellectual property is created and the PI has completed the statement of work, the PI can close out the grant.

Technology Transfer Process

The process through which PIs commercialize technology created during their research is shown in the following figure.

Figure 4

Technology Transfer Process



Source: Compiled by the Legislative Audit Division from University records.

Chapter II – Background

To begin the technology transfer process, a PI completes an invention disclosure form. Once the technology has been disclosed, if the office agrees the invention has commercial potential, it will carry out a patent literature search and review. For most universities a patent attorney is hired to conduct this search. With help from the PI, the technology transfer officer will make a preliminary evaluation of novelty and feasibility of the technology, possible markets, development stage, and patentability. For the most part, if technology is novel, useful, non-obvious, and has commercial potential the office will proceed with a patent application.

Although the technology may receive a patent, this does not guarantee it will be licensed and produce royalties. For a patent to be marketed and licensed the cooperation of industry is needed. If a company has interest in the technology, a license agreement is negotiated. When licensed to a company, the technology provides a benefit to the company. The University shares in the benefit in the form of royalties.

Research and New Business Activities in Universities

Passage of the Bayh-Dole Act has had a significant impact on the scope and direction of R&D activities within universities. Traditionally, scientific discoveries and technological innovations developed through university-based research programs received limited attention from commercial development. By providing incentives for both universities and individual researchers to develop intellectual property and pursue technology transfer, Bayh-Dole introduced universities to a new business activity. Universities in Montana and in most other states have adapted administrative and management procedures to reflect these changing circumstances and take advantage of newly available opportunities. Another significant factor in the development of R&D programs in Montana's universities has been the significant growth in the funding available for these activities. National and state trends in research funding are discussed in the next section.

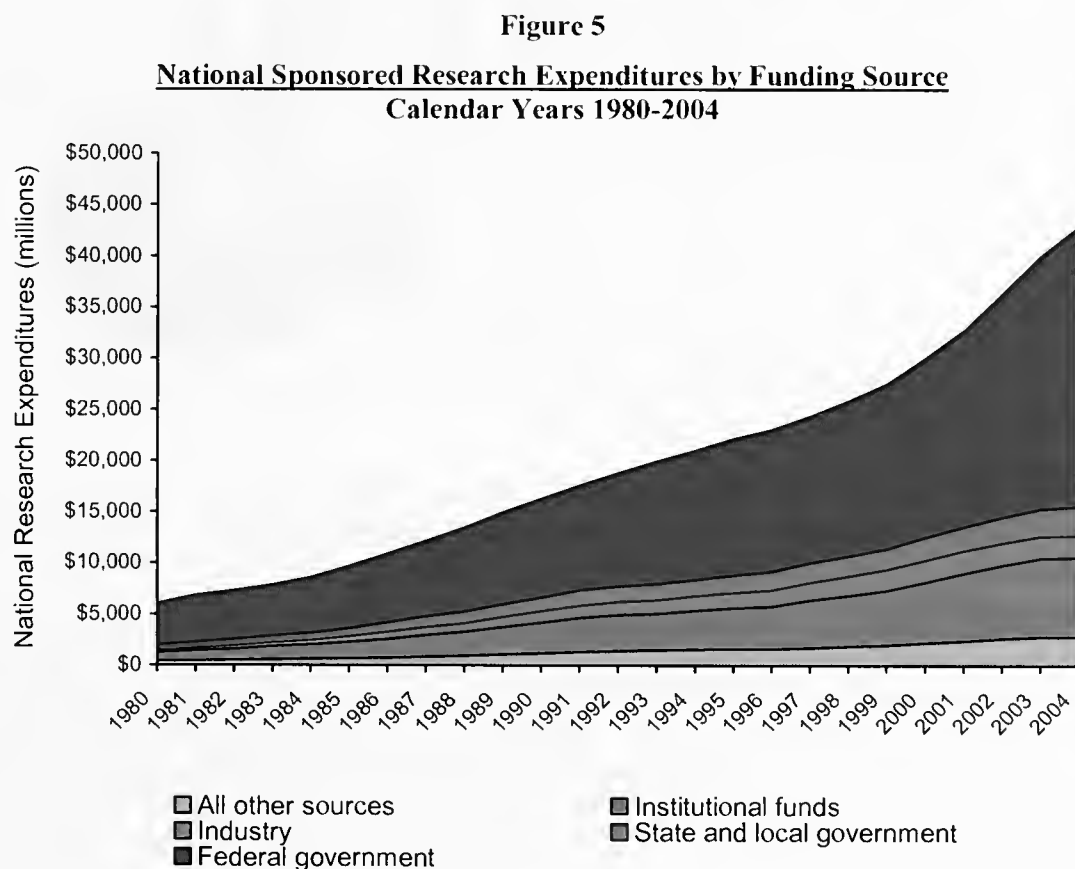
Trends in Research Funding

Funding for research at universities is available from multiple sources. Although the federal government provides the majority of

the funding, universities can also access grants and contracts for research from state and local governments, private industry, and other universities. The majority of data used in our analysis is sourced from the National Science Foundation, which regularly surveys universities around the country to assess levels of research activity.

National Trends

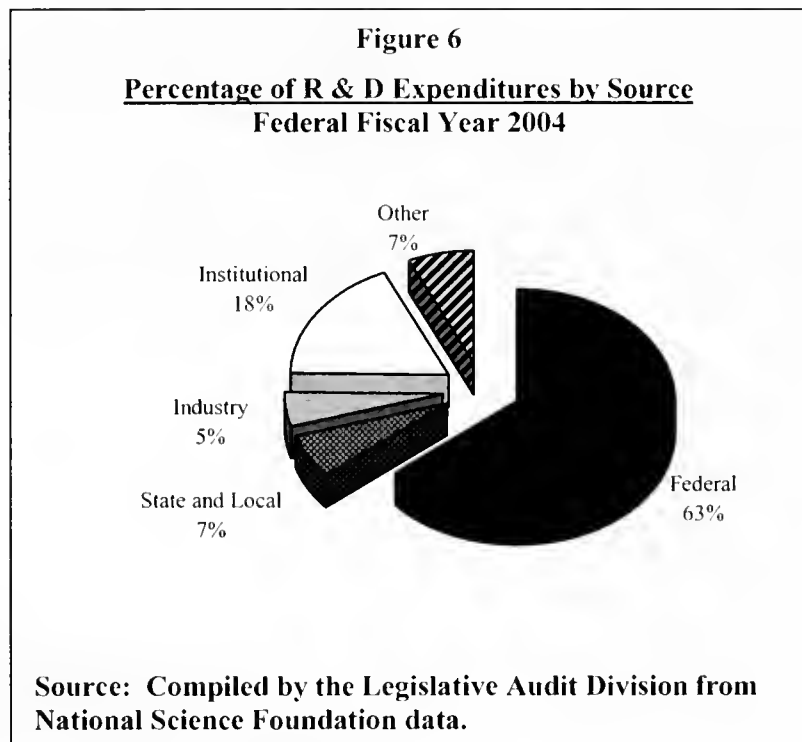
Currently two ways to track R&D dollars exist, obligations and expenditures. Obligations are binding agreements between the university and the grantor agency resulting in cash disbursements in the future. Expenditures are research funds spent by the university during its fiscal year. The following figure depicts the growth in research expenditures by source from 1980 to 2004.



Source: Compiled by the Legislative Audit Division from National Science Foundation data.

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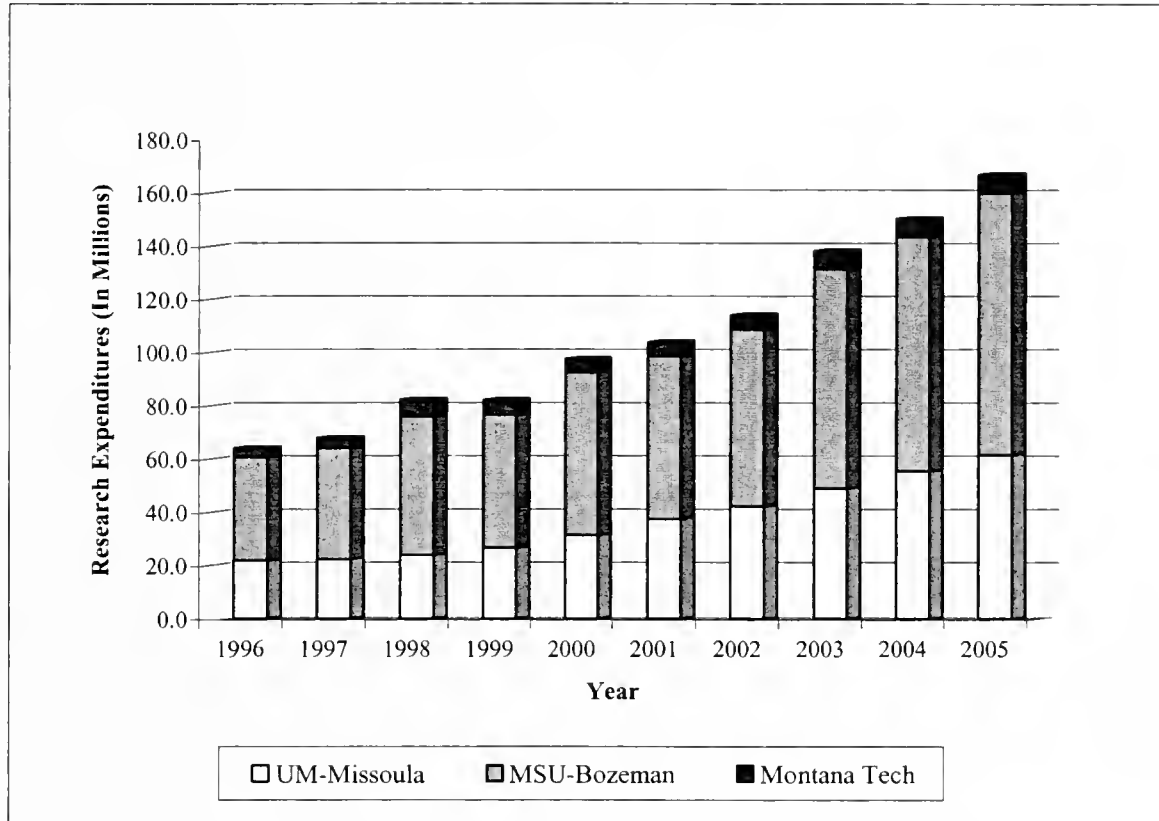
In recent years federal funding has fueled most of the growth in research. According to the National Science Foundation (NSF), universities reported \$43.9 billion in research expenditures in 2004, over double the \$21.0 billion expended in FY 1994. Of this \$22.9 billion increase, the federal government contributed \$14.7 billion. While total federal research dollars have increased, the percentage of expenditures by funding source has stayed relatively constant. The following figure illustrates the percentage of expenditures by source for FFY 2004. Non-profits are included in the “other” category.



State Trends

Overall increases in research funding at the national level have also been reflected in funding trends for Montana's state universities. The level of research funding for the MUS has been increasing steadily over the past decade. Figure 7 illustrates the trends in MSU, UM, and Tech research expenditures between 1996 and 2005.

Figure 7
Selected MUS Units' Research Expenditures
Fiscal Year 1996-Fiscal Year 2003



Source: Compiled by the Legislative Audit Division from University records.

MSU more than doubled its research expenditures from \$38.7 million in 1996 to \$98.5 in 2005 and UM almost tripled its research expenditures from \$22 million in 1996 to \$61.6 in 2005. Montana Tech research expenditures have grown from \$3.5 million in 1996 to \$7 in 2005. In the last ten years, as a system, MUS research activity more than doubled from \$64.2 in 1996 to \$167.1 in 2005.

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Peer Universities Level of Research

During audit work, we conducted an analysis of peer universities around the nation. Peer universities were selected based on criteria including participation in the National Science Foundation (NSF) Experimental Program to Stimulate Competitive Research (EPSCoR) state program, level of funding from federal agencies for research, and location. The table below shows peer universities' average research expenditures for the FY1996 to FY2003.

Table 1

**MUS and Peer Institutions Average
Sponsored Research Expenditures
Fiscal Year 1996 – Fiscal Year 2003**

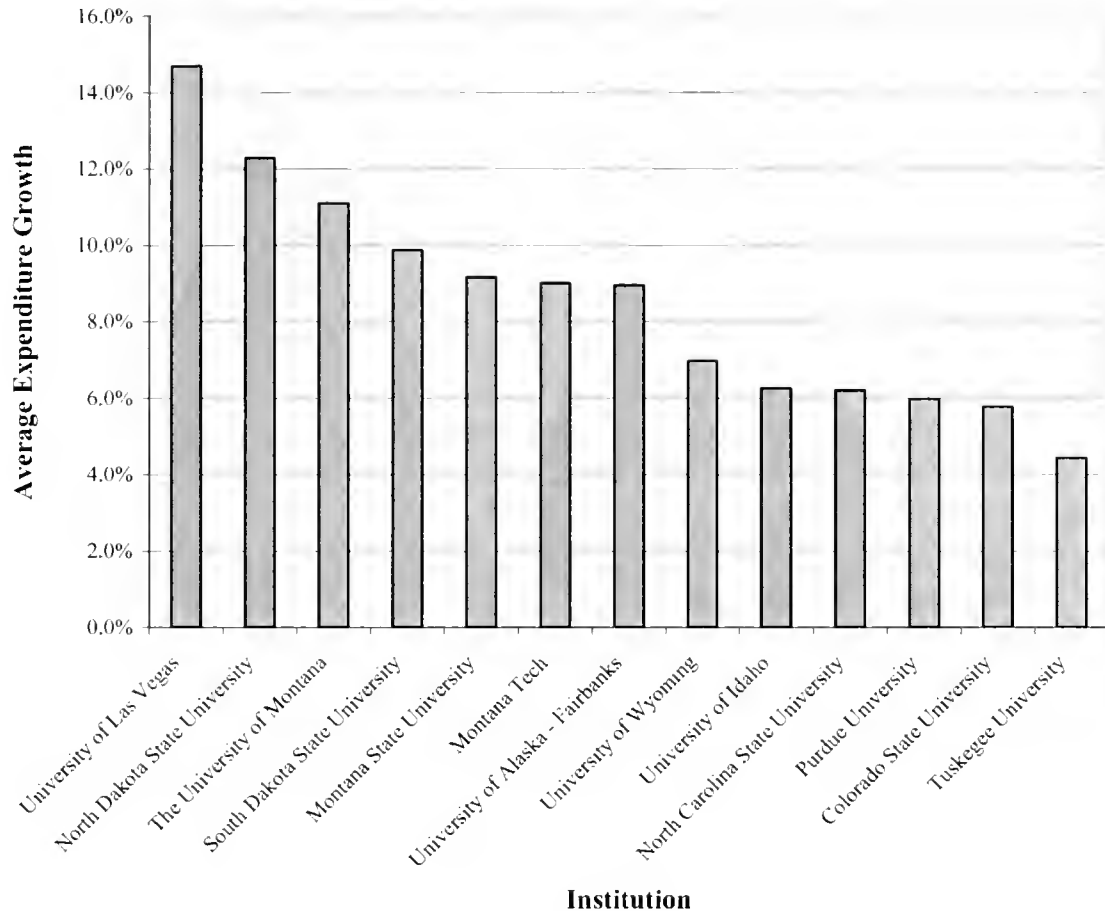
<u>Peer Institution</u>	<u>Eight Year Average Annual Expenditures (millions)</u>
Purdue University	\$242.6
North Carolina State University	\$262.3
Colorado State University	\$153.1
University of Alaska - Fairbanks	\$95.6
University of Idaho	\$65.8
Montana State University	\$64.0
North Dakota State University	\$55.3
University of Wyoming	\$46.3
The University of Montana	\$29.1
University of Las Vegas	\$24.2
South Dakota State University	\$18.3
Tuskegee University	\$15.9

Source: Compiled by the Legislative Audit Division from National Science Foundation data.

We also addressed the rate of growth in research expenditures for MUS universities and comparable peer universities. The next figure compares MUS universities research expenditures percentage of growth to peer universities. Average expenditure growth ranged from 5.8 percent to 30.2 percent. MSU average percentage of

growth from FY1996-2003 was 9.2 percent, UM 11.1 percent, and Tech 9.0 percent.

Figure 8
Peer Institutions' Average Expenditure Growth
Fiscal Year 1996-Fiscal Year 2003



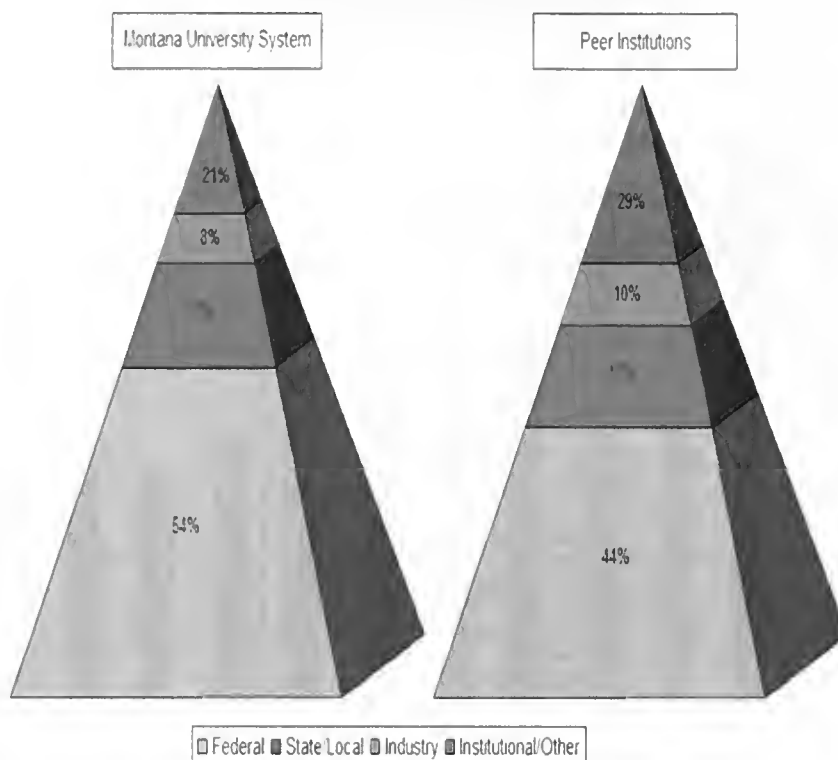
Source: Compiled by the Legislative Audit Division from National Science Foundation data.

Funding Sources for MUS Research

Part of our analysis also involved examining the source of research funding for Montana's universities. Research funding by source for MUS units and comparable institutions is shown in the following chart.

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Figure 9
Sponsored Research Expenditures by Source for
MUS and Peer Institutions
Federal Fiscal Year 1996- Federal Fiscal Year 2004



Source: Compiled by the Legislative Audit Division from National Science Foundation records.

Comparison with peer institutions' funding sources show Montana's universities attract research funding in broadly similar proportions, but tend to rely on federal funding to a greater extent. However, the overall picture shows MUS universities are nationally comparable with their research proposals and have had similar growth in research to the nation and peer universities.

Conclusion

Montana universities are nationally competitive in obtaining research funding and have seen growth in research funding consistent with peer institutions.

Chapter III – Administration of Research Programs

Introduction

This chapter outlines the procedures MUS universities follow in order to manage research programs. Audit work addressed the effectiveness and efficiency of these procedures and the extent to which university research offices are meeting the needs of faculty engaged in research. The following sections discuss identification of funding opportunities, management of the proposal submission process, grantor agency peer review procedures, and post-award management. Results of our file reviews and other audit work are also addressed, followed by recommendations relating to improvements in the administration of research programs

University Management of Research Programs

Principal investigators (PI) are generally aware of activities taking place in their area of research and usually have advanced knowledge of funding opportunities available to them. However, if a PI is having difficulty identifying sources for funding, the Office of Sponsored Programs (OSP) can provide assistance in a variety of ways. At MUS universities, the OSP can assist PIs in identifying sources of funding available from different governmental and private organizations. Montana's OSP offices currently subscribe to databases in which PIs can perform searches on funding opportunities. The offices also have their own databases in which they track faculty research interests. The universities have email services used to notify PIs of research opportunities corresponding with their current research interests.

Our review showed MUS universities are following industry standards and best practices when providing information to faculty relating to research. Results from our survey of university faculty and staff indicated a high level of satisfaction with the efforts of the OSP in this regard. For the university system as a whole, more than 75 percent of respondents indicated they were satisfied or very satisfied with the accuracy and timeliness of notifications of research funding opportunities.

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Conclusion

MUS Universities follow best practices in communicating sponsored research funding opportunities to principal investigators.

Proposal Submission Procedures

For the most part, MUS universities have similar processes for submission and management of grants, although some minor differences exist. All MUS universities have proposal clearance forms or proposal approval forms. These forms need to be filled out by the PI before their proposal will be accepted by the OSP. This document helps ensure the proposal is properly routed, documented, reviewed, and approved. Proposal forms include information indicating whether the proposal has gone through the correct review committees, a conflict of interest disclosure, budget information, and cost allocations.

The PI is responsible for putting together the grant proposal, which consists of technical and budget sections. The OSP will assist the PI with the budget section of the proposal, if needed. Once a proposal form has been filled out by the PI and receives appropriate departmental approvals, it is reviewed by OSP personnel to assure required authorization has been received and the budget is correct. All MUS universities require PIs have the proposal, the approval form, and the final budget turned into the OSP offices 24 to 48 hours before the grantor agency's submission date.

Once approved by the OSP, the authorized representative of the university (the Vice President for Research or designee) will sign off on the proposal. By signing the proposal form, the VP binds the university to the proposal. Many sponsors now require electronic submission. As with paper proposals, the proposal must still be authorized by a representative of the university before being submitted to the funding agency.

Peer Review of Competitive Research Grants

For the majority of research grants, grantor agencies use a peer review process and award grants on a competitive basis. Proposals from Montana's universities are compared with other grant proposals

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from universities around the nation. The peer review process is defined as a review of technical or scientific merit by individuals with sufficient technical competence and no unresolved conflict of interest. Peers generally are considered to be academics with qualifications and expertise equivalent to those of the researcher whose work they are reviewing. Examples of federal agencies that have laws or regulations that require peer review of competitively selected grant proposals include the National Institutes of Standards and Technology, the National Institutes of Health, the Department of Energy, the Environmental Protection Agency, and the National Aeronautics and Space Administration.

Indirect Cost Recovery Rates

Development and submission of budgets for research usually involves an indirect cost recovery, also referred to as a facilities and administration rate. The indirect cost rate is generally based on rates negotiated with the federal government. This amount partially reimburses the entity for the administration, infrastructure and other support services universities provide for research activities. Indirect cost recovery rates vary depending on the source of funding (federal, state or local government, or private sources), and also vary between different universities. Montana's universities use indirect cost recoveries for various purposes, including administration of research programs through Vice Presidents' offices. We obtained information on indirect cost rates applied by Montana universities and selected peer universities, which is shown in the following table.

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Table 2
On-Campus Research Indirect Cost Recovery Rates for
MUS and Peer Institutions
Fiscal Year 2006

<u>Institution Name</u>	<u>Federal Indirect Cost Recovery Rate</u>
Purdue University	52.0%
University of Nevada – Las Vegas	47.5%
University of Alaska - Fairbanks	47.5%
University of Idaho	46.3%
North Carolina State University	46.0%
Colorado State University	46.8%
South Dakota State University	43.0%
North Dakota State University	42.5%
Montana State University - MSU	41.5%
The University of Montana - UM	41.0%
University of Wyoming	40.5%
Average Rate	44.8%

Source: Compiled by the Legislative Audit Division from MUS and peer institution records.

The rates shown in the table are negotiated with the federal government by individual universities. Montana's rates are generally lower than the average for peer universities. Many factors can affect indirect cost rates, but the size/scale of a university's research facilities are often a deciding factor.

Conclusion

Indirect cost recovery rates assessed by Montana universities for federal research awards are generally consistent with peer institutions.

Grant Announcement and Award Management

When a grant is awarded to the university, the OSP is notified of the award. Once the award is accepted and approved by the OSP offices, a fund number is assigned and the PI may begin charging allowable project expenses against the account. The OSP offices at MUS universities monitor and review PI expenditures on grants and

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are in charge of financial accounting reporting for the grant. The PI is responsible for the day-to-day administration of the grant and technical reporting requirements to the funding agency.

Files were reviewed at MUS universities to identify whether they are following policies and procedures for proposal submission and award management. A total of 26 randomly selected files were reviewed at the three main MUS research universities. Review identified whether appropriate review of the proposal had taken place, whether the university had signed-off on the project, and whether the PI was authorized to proceed once the grant had been awarded. No significant concerns with the universities' administration of research programs were identified. In general, universities are exercising their oversight functions in a diligent manner and ensuring adequate controls are in place. For all the individual grants or contracts we included in our review, universities ensured scrutiny of the proposals and required authorization occurred at the appropriate times.

Conclusion

MUS Universities have implemented appropriate controls for management of sponsored research projects and programs.

Audit Findings Relating to Research Administration

Research funding is still growing in Montana as UM and MSU report more than \$163 million in expenditures for FY2006, a \$3 million increase from FY2005. As the volume of funding for research continues to grow, MUS universities will face challenges in how they monitor and report these activities to the BOR.

For MUS to better manage research activities there needs to be consistency in how research activities are reported to the BOR and other entities. An example of how the Office of Commissioner of Higher Education (OCHE) collects data from all Montana universities consistently is enrollment data. A registrars' manual for reporting enrollment data has been developed in order to ensure MUS universities report data consistently. BOR has constitutional

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and statutory responsibility and authority to supervise, coordinate, and manage the MUS. In order for the BOR to effectively carry out these responsibilities, universities need to report research activities consistently.

Audit work showed MUS could improve procedures for identifying, tracking and reporting research activities to ensure relevant data is consistent between MUS universities. Findings relative to these issues are discussed in the following sections.

MUS Universities Should Report Research Data Consistently

UM currently reports on its research website the number of proposals submitted, amount received, and Ph.D.s awarded. The university also has an annual publication called “Vision” in which the past year’s research activities are highlighted. MSU has a research and creative activities report published each year. This report includes expenditures, expenditures by sponsor, and expenditures by colleges and departments. The document also includes articles related to research activities.

Peer universities track data in a more consistent manner than MUS universities and have the ability to communicate research activities more effectively. For example, North Dakota State University puts out an annual report for external funding awards. This publication contains R&D data including: total dollars requested from external funding sources, proposals processed and awarded, obligations, number of external awards, federal awards by agency, expenditures, infrastructure improvement programs, science outreach and recruitment, technology transfer, and external grant detail.

MUS Should Standardize Reporting of Research Data

For data on grantor agency obligations and university expenditures to be comparable between universities, they must be based on the same definitional criteria and time period. MUS universities do not use the same criteria when reporting and tracking research data. The ability for MUS universities to independently develop their own reporting methodology has led to gaps and variances in the data. For example MSU reports data on expenditures while UM reports obligations. While these numbers may be useful to individual

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universities to track research activities, they do not report research activities consistently. This creates difficulty for outside entities including the BOR, legislators, and other institutions, to analyze system-wide data.

Consistency in the types of data reported and the compilation methods used is important for governing entities such as the BOR. Using different types of measurements or quantifying data in different ways makes it difficult for BOR to provide effective oversight of research activities. The approach BOR and OCHE use in compiling and reporting enrollment data for the MUS provides a good model of consistency. The BOR has defined which enrollment data is relevant and requires all universities to report the numbers in a consistent fashion.

As the overall level of funding for research increases, the university system faces more demands for consistent reporting on these activities. The BOR has a constitutional and statutory responsibility to supervise, coordinate, and manage the MUS, including research activities. To discharge this responsibility fully, the Board should require relevant and consistent reporting on research activities from all campuses. Development of reporting requirements for research activities should involve identifying relevant metrics or data, ensuring campuses are tracking data in a consistent manner, and requiring regular and consistent reporting from all universities.

Recommendation #1

We recommend the Board of Regents ensure consistent reporting of data relating to research activities on MUS campuses.

Areas for Improvement in Research Programs Administration

Although we did not identify significant concerns with the universities' administration of research program, we identified several areas where MUS universities could make improvements in their operations. Areas for improvement relate to consistency in use of information systems in managing research awards, specializing

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functions for OSP staff, and training programs provided for principal investigators. These issues are discussed in the following sections.

Use of Information Systems

Universities with large volumes of research funding increasingly rely on information systems to manage workload associated with grants/contracts and provide accurate reports on these activities. The Banner financial reporting system currently used by MUS universities provides the necessary functionality for managing information on research programs.

Our review of procedures in research offices showed MUS universities vary in the way information systems are used. MSU currently uses Banner in both the pre and post-award functions. UM currently uses Banner only for post-award functions and maintains a separate stand-alone database application for pre-award functions. We also noted examples from peer universities in other states where Banner or similar information systems were integrated seamlessly through both pre and post-award functions.

Universities Could Benefit from Full Integration of Banner

Maintaining separate systems for pre-award functions involves additional time and effort for OSP staff and duplicates efforts already directed towards Banner functionality. For example Banner supports proposal and grant tracking, accounting, and reporting.

Full integration of Banner functionality in both pre and post-award functions could benefit MUS universities where this integration has not already occurred and is cost effective. Benefits include elimination of costs associated with maintaining a duplicate system. Another benefit for campus administrators is the improved security and stability offered by an enterprise system, and additional improvements in functionality and reporting capabilities.

By providing pre-award staff at UM with the appropriate guidance and training in incorporating Banner into its functions, research data among the MUS universities could be tracked more consistently across all reporting units. Ensuring a system-wide approach to the use of information technology should be a responsibility of the BOR

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through the Office of the Commissioner of Higher Education, the organization best placed to coordinate these efforts in different component units of the university system.

Recommendation #2

We recommend the Board of Regents through the Office of the Commissioner of Higher Education coordinates the use of information systems within research administration functions.

Departmental Specialization in Research Administration

Another area for improvement we identified relates to specialization of functions for OSP staff. OSP staff (pre-award functions) at UM are not assigned to specific departments within the university, but may work on various departments' proposals and budgets. When looking at comparable universities, the majority of universities have implemented departmental specialization within their pre-award office. These universities included the University of Alaska, University of Nevada-Las Vegas, Colorado State University, North Carolina State University, and Purdue University.

The UM Grant Accounting Office (Post-award functions) assigns its staff to specific departments for grant administration and management. This allows the staff members to become familiar with PIs within the department and also, the departmental policies and procedures. As the volume of research has grown over the years, the importance of specialized knowledge has also increased. From 1997 to 2006 research proposals submitted at UM has grown from 555 proposals a year to 689 proposals.

Standardized Approach to Departmental Specialization

UM has not made changes to the structure within the Office of Research and Sponsored Programs (ORSP) to reflect increasing grant volumes. A non-specialized staff in previous years worked well for the university; however, grants and grant award volume are increasing and in order for the university to keep up with the growth in proposals and awards it is important staff are specialized in specific departmental research areas. Not only is the level of

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proposals being submitted to agencies increasing, but the complexity of policies and procedures adopted by grantor agencies is also increasing.

Research administration functions in other MUS units and peer institutions have moved towards staff specialization to ensure pre and post-award functions have the necessary skills and knowledge to handle increasing levels of complexity. Where pre-award staff concentrate on grants and contracts for specific departments, they to develop skills and knowledge specific to particular grantor agencies and organizations. University departments are likely to benefit through more regular contact between administrative and research staff and access to agency-specific knowledge for particular grantors.

Recommendation #3

We recommend The University of Montana - Missoula assign pre-award staff within the Office of Sponsored Programs by departmental specialization.

Training Programs for Principal Investigators

MUS universities offer research training sessions to PIs. During these training sessions, PIs learn about how to find funding opportunities and other information related to grant administration. Training in issues relating to research is important because PIs are responsible for many aspects of grant administration and federal agencies' policies and procedures are becoming more comprehensive than in the past. For example, the National Science Foundation and the National Institute of Health have their own grant policy manuals. The development of agency-specific policies and procedures adds to the compliance burdens already imposed by Office of Management and Budget (OMB) Circulars and other federal and state laws and regulations.

If PIs are not fully aware of their responsibilities under these various directives, universities run the risk of grantor agencies excluding them from grants because PIs are not following applicable laws and regulations. For example, OMB circulars and other federal

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directives address the issue of conflict of interest for individuals working on awards or involved in administration. It is important that university staff and faculty have a sound knowledge of these issues, yet in responses to our survey, less than half of MUS PIs stated they had received guidance on disclosure of conflicts of interest in sponsored research. The most obvious and most effective method of mitigating these kinds of risks is the provision of appropriate training.

We identified two areas for improvement relative to PI training programs at MUS universities. Attendance at training has not been made mandatory across all units of the system. The current training model may be too broad in nature and may not serve specific needs of different research faculty.

Mandatory Training in Core Elements of Research

UM training is not mandatory for PIs to attend, however the office has discussed making the training mandatory. MSU just implemented a policy in which all PIs are required to attend training. MSU staff stated since making the training mandatory, the PIs have more exposure to policy and procedures in place. While it is not necessary for a PI to gain a comprehensive knowledge of all federal and state requirements applicable to research, a certain minimum level of knowledge of important elements should be expected.

Optional Training in Specific Topics

Currently, training provisions at MUS universities could be described as a ‘one size fits all’ approach. Faculty and staff are presented with large volumes of information on diverse topics, some of which may not be immediately relevant to their role in research programs. Review of training provision in peer universities showed a general trend towards more diversified and topic-specific training provision for faculty and staff. For example, the University of Alaska – Fairbanks offers faculty and staff involved in research numerous optional training in courses in specific topics on a regular basis. MUS universities could duplicate this approach to training by providing optional topic-specific training sessions, in addition to mandatory attendance at training covering core elements.

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In developing training courses for both the mandatory and optional elements, MUS universities could work cooperatively to define content. By pooling their combined resources, universities could access expertise in specific subject areas, while also ensuring a degree of consistency in training provisions across the system.

Recommendation #4

We recommend Montana University System universities:

- A. Develop and implement mandatory training content addressing core elements in research; and**
- B. Provide faculty and staff with additional training opportunities as needed, related to specific subjects relevant to different aspects of the administration and management of research programs.**

Increasing Research Administration Responsibilities for Universities

With the increase of research funding nationwide, universities have been required to adjust administrative policies and procedures to help manage these activities better. MUS universities have adapted their administrative processes to reflect new circumstances. The recommendations included in this chapter are designed to help the MUS improve research administration functions and achieve a greater degree of consistency between different institutions. If external funding for academic research continues to increase, the MUS should be well placed to ensure effective management of these resources in the future.

Chapter IV – Earmark Funding

Introduction

This chapter outlines the procedures MUS universities follow when applying for earmarked funds, the growth in earmark funding, and the Board of Regents involvement in such activities. Audit work addressed earmark funding procedures including developing and reviewing earmark requests. This chapter includes a recommendation that is designed to provide additional opportunities to review earmark funded proposals.

Review of Earmark Funding

Earmark funding is another term for appropriations to federal agencies requested by members of Congress specific for projects or programs. Earmarks are generally differentiated from regular appropriations because they are not requested as part of the usual federal agency budgeting process, they are not included in the President's budget, and they are applicable to a named project or program.

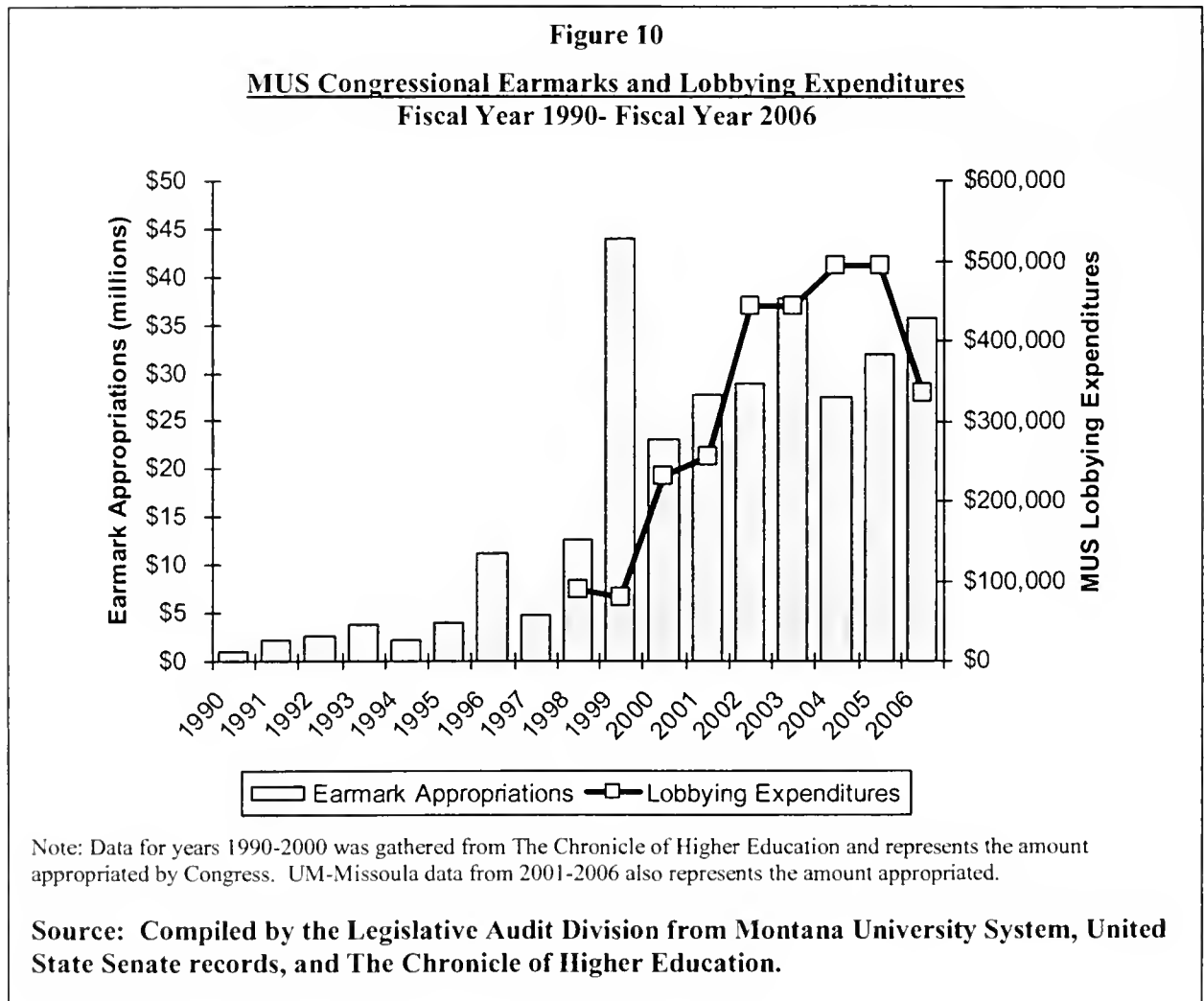
Universities have been major beneficiaries of the increase in earmark funding, which has been used to fund research programs and make investments in equipment and infrastructure. In the context of university research, earmarks are differentiated from the usual means of funding because they have no competitive element. The vast majority of funding for research is secured on a competitive basis in which universities around the nation submit grant proposals. These proposals go through a peer review process prior to selection. Earmarks bypass this competition process; projects and programs are funded with granting agency oversight, but without any competitive scrutiny.

Trends in MUS Earmark Funding

Montana's universities have become increasingly adept at attracting earmark funding in recent years. The level of earmark funding has increased in line with the rise in overall research expenditures at Montana's universities. In addressing the issue of federal funding for university research, a related factor of importance is university expenditures for lobbying and other federal relations activities. Both UM and MSU retain the services of outside lobbying firms to assist in their efforts to secure earmark funding. Besides conducting

Chapter IV – Earmark Funding

lobbying, these firms assist in the process of understanding federal government functions and help universities prepare for working with federal grantor agencies. Expenditures to these lobbying firms have also increased over recent years to roughly \$500,000 annually. The following chart depicts the growth in MUS earmarks and lobbying expenditures in past years.



MUS Procedures for Developing and Reviewing Earmark Requests

Currently, MUS universities have procedures in place when applying for earmarked funds. At the universities we reviewed, proposals are sent and reviewed by a committee, which includes the Vice President for Research (VPR). This committee, in consultation with university presidents, reviews and selects those proposals which will be

provided to the President of the university who signs-off on the list before it is given to the federal delegation.

When universities apply for federal research grants and contracts, they compete against various universities around the nation. Only those universities whose proposals are selected during the peer review process are funded. The peer review process ensures research proposals are funded based on merit as determined by expert and knowledgeable reviewers. While this holds true for most university research grants and contracts, earmarks funded grants and contracts will not go through this type of review when being selected. Earmark requests do not compete against multiple universities around the nation nor are they subject to a peer review process. This does not mean earmark requests have no merit, but it does mean these proposals are judged on a different basis from most other externally-funded research in Montana's universities.

While earmarks are beneficial in terms of research resources and infrastructure, they do not receive the same level of review as other research proposals. Within the MUS, earmark requests do not receive any review beyond the university level and are not truly subject to a competitive process. Of particular note is the lack of involvement by the Board of Regents in review of earmark requests. The Board has responsibilities under the state's constitution and laws to coordinate and manage the university system. Review of the agendas and minutes of the Board show a significant level of oversight activity relating to many different aspects of the university system, but no discussion of what has become a significant source of funding for research-related activities at universities. The Board has not developed an approach to identify information needs relevant to earmarked funding.

Governance and control of the MUS is vested with the BOR, which has full power, responsibility, and authority to supervise, coordinate, manage, and control the MUS. In terms of research, the Board has the responsibility to manage research programs, which include earmark requests. Under its authority to manage the system the BOR

Chapter IV – Earmark Funding

could provide additional review of earmarks, which would strengthen its understanding of this important subject.

Board of Regents Should be More Involved in Review of Earmarks

Recent growth in earmark funding emphasizes the importance of understanding of these funding proposals. The involvement of the BOR in reviewing and understanding earmark proposals would provide additional opportunities to assess the viability and suitability of different proposals. The board's input could also ensure earmark proposals are coincident with universities' missions and are in the best interests of the university system as a whole.

Recommendation #5

We recommend the Montana Board of Regents address its role in the process of direct congressional appropriations by:

- A. Identifying information relevant to earmark funding to be compiled by universities; and**
- B. Becoming more involved in the understanding and review of these funding sources.**

Universities are not only responsible for grant administration; they are also responsible for the patenting, licensing, and marketing of intellectual property developed through university research. Changes in federal law have resulted in universities focusing on the area of technology transfer and responsibilities relating to the commercialization of creative works developed through research. MUS universities, along with other universities across the nation, have realized the need for technology transfer offices to handle these activities. Audit work addressed the extent to which Montana's universities have developed effective and efficient means of transferring technology. Information and findings relating to university technology transfer functions are addressed in the next chapter.

Chapter V – Technology Transfer Functions

Introduction

The following chapter discusses technology transfer functions and activities at Montana University System (MUS) universities. Montana's two main research universities (UM and MSU) both maintain technology transfer offices (TTO). The primary function of the TTO is to identify, protect and market intellectual property (IP) developed as a result of research activities. In relation to the broader concept of 'research and development,' technology transfer functions enable universities to complete the 'development' of research-generated technologies, processes, or ideas. The TTO provides a link between universities and private sector businesses or organizations and facilitates the transfer and exchange of commercially viable knowledge.

Audit work addressed various aspects of TTO functions, including the identification and disclosure of technology, the patenting and licensing processes, IP management, and marketing of technology to the private sector. This chapter includes narrative descriptions of technology transfer functions, and discusses findings relating to the performance of these functions by university TTOs. Technology transfer is a growing activity for many universities and these functions are in early stages of development at MUS universities. The recommendations included in this chapter are designed to provide guidance and highlight areas for improvement in future management of technology transfer functions.

Technology Transfer Activities

Audit work addressed the management of the technology transfer process by Montana's universities. We identified three main processes or stages of the technology transfer process as follows:

- ▶ Identification and disclosure of intellectual property
- ▶ Protection of intellectual property through patenting
- ▶ Marketing and licensing technologies for commercial applications.

The following sections provide narrative descriptions of these different aspects of technology transfer process and findings relating

Chapter V – Technology Transfer Functions

to the policies and procedures put in place by the MUS to facilitate technology transfer.

Identification and Disclosure of Intellectual Property

Faculty members participating in research are required to disclose any technologies, processes, products, ideas, or other creative works, with commercial potential to the TTO. This disclosure allows the office to assist the faculty member in protection and subsequent commercialization of their technology.

Once a technology has been disclosed the office will evaluate the technology to identify whether it is commercially viable and assess the market potential of the technology. When conducting a market analysis, the PI is involved in discussion of possible markets that exist for the technology, the manufacturing feasibility (early stages or latter stages of development), and the probability of patenting the technology.

Patenting Process

If the TTO decides to patent the technology, it will proceed with a patent application. MUS universities will hire a patent attorney to assist in filing a patent. Patent attorneys perform a patent literature search and review, which includes reviewing professional journals, public disclosures, prior related patents, etc. A patent attorney is hired because a clear understanding of the ways an invention is new, useful, and non-obvious are essential to obtaining a patent.

When deciding to patent a technology the TTO decides whether it will file a provisional or conventional patent. A provisional patent is a less expensive type of patent that functions as a place holder to give more time to evaluate a new technology and identify markets for the technology. Within a year after filing, the university must decide whether to file a conventional patent. Generally speaking, a provisional will not be converted to a conventional patent unless a company wishing to license the technology is identified. A conventional patent, if issued, lasts for 20 years from the patent application's filing date.

Chapter V – Technology Transfer Functions

Marketing and Licensing Technologies

In order for the technology to actually hit the marketplace and benefit society, companies outside of the university are needed. When working with individual companies and disclosing information, MUS universities use confidentiality agreements. Once this agreement is signed by the company, the university is able to share confidential information with the company, without losing its rights to patent the technology.

When a company requests to use the university's technology, a patent license is needed. A patent license allows the company to use the technology and make and sell products; however the university will still retain the ownership of the technology. If a company produces revenues using the university's technology, the university will receive a share of the profits through royalties. Royalties are first used to reimburse the university for expenses incurred during the patent process. Once the university has recovered its expenses, the university splits royalties, based on a predetermined percentage, with the inventor.

Montana Universities are Developing Technology Transfer Capacity

Audit work showed that Montana's universities are developing the necessary functions and processes to successfully pursue technology transfer goals. Both the main research campuses at UM-Missoula and MSU-Bozeman have established technology transfer offices and have gained several years experience in identifying and protecting intellectual property developed through research. Universities are also pursuing commercialization opportunities through licensing agreements. State law contains provisions authorizing and facilitating technology transfer and campus technology transfer activities are governed by policies and procedures established by universities and the Board of Regents.

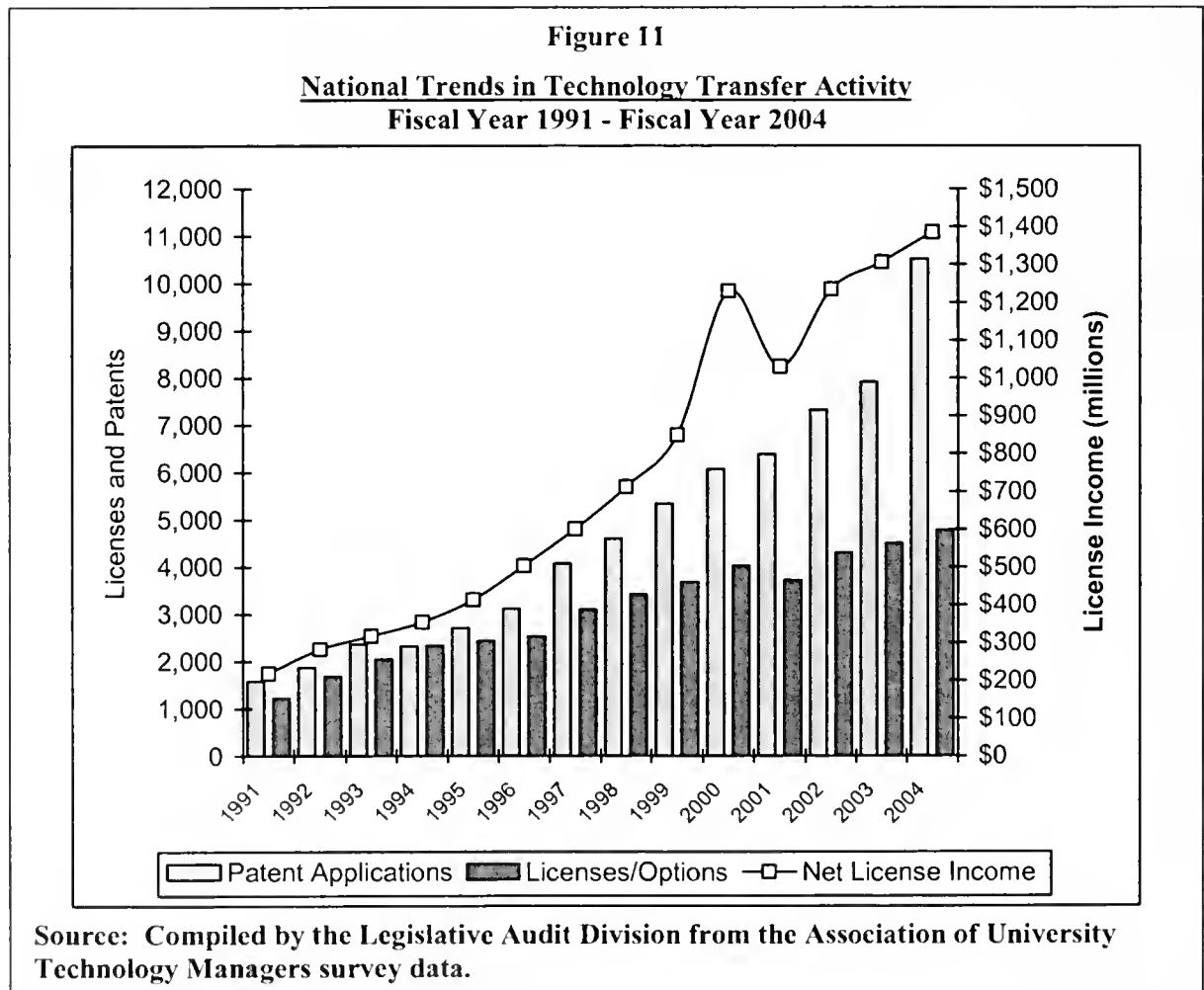
Conclusion

Montana's Universities are developing the procedural and functional capacity necessary to successfully pursue technology transfer.

Chapter V – Technology Transfer Functions

National Trends in Technology Transfer

University technology transfer activities can be measured in a variety of ways. Some of the most common metrics used to track the growth in these activities include the number of inventions disclosed, number of patent applications and/or filings, number of licenses or options executed, and the income received from licensing royalties and other revenues. The Association of Technology Transfer Managers (AUTM) is a national membership organization representing technology transfer managers, mainly from universities and research organizations. AUTM conducts annual surveys of its membership to track trends in technology transfer activities. The following figure illustrates trends in various technology transfer activities between FY1991 and FY2004.



Chapter V – Technology Transfer Functions

As shown in the figure, levels of technology transfer activities are increasing in all major categories. Between 1991 and 2004, the numbers of patent applications and licensing activity have increased by an annual average of 16 and 12 percent respectively. In line with this trend, the net income generated by licenses has increased from \$218 million in 1991 to \$1.4 billion in 2004, an annual average increase of 16 percent.

National Trends Suggest Technology Transfer is Becoming a Significant Business Activity for Universities

Increasing levels of federal support for university research, coupled with provisions of federal law mandating technology transfer, have resulted in significant growth in invention disclosures, patent applications and licensing activities for universities around the country. Universities are becoming increasingly aware of the potential commercial value of creative works produced through research and of the impacts resulting from technology transfer (see Chapter VI for more discussion regarding the economic and human impacts of technology transfer). National data compiled by AUTM suggests that technology transfer is growing in significance for universities as both a necessary business function and a source of revenues.

Conclusion

Technology transfer is becoming an increasingly significant business activity and source of revenues for the nation's universities.

University Technology Transfer Efforts Could be Improved

Audit work relating to technology transfer functions of MUS universities included interviews with university administrators and other faculty and staff involved in the process, review of documents and other information on patenting and licensing activities, analysis of survey responses addressing technology transfer, and review of comparative data from universities in other states. We have identified several areas where we believe universities could improve the following aspects of technology transfer functions:

- ▶ System policy relating to invention disclosure and preliminary patent searches.
- ▶ Capitalization procedures for intellectual property assets.

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- ▶ Visibility and awareness of technology transfer functions on MUS universities.
- ▶ Integration of technology transfer in university strategic planning functions.

Montana Board of Regents Policy

Currently the Montana Board of Regents (BOR) has policy in place related to MUS technology transfer activities. Policy 40I.2 states once a PI supplies the TTO with an invention disclosure, the office has 60 days to conduct a preliminary patent search or release the discovery to the PI. It also states the office has eight months to file a patent following a disclosure.

Review of documentation relating to invention disclosures and patenting showed universities are consistently extending timeframes outlined in BOR policy. For example, MSU currently has a form which extends this timeline indefinitely. The form is currently filled out for all invention disclosures at MSU and has become redundant because the office cannot effectively patent the technology within eight months of the technology being disclosed.

BOR Patenting Timeframes are Inconsistent with Current Practices

Our review of MUS technology transfer activities shows the current timeframes established in BOR policy are not consistent with actual practice. Establishing timeframes for technology transfer activities is necessary to ensure the process is well-managed. Management can use process timeframes as a means of assessing progress in meeting program objectives, but only where the prescribed timeframes are meaningful. The timeframes established for preliminary patent search following invention disclosure do not appear to be meaningful, given the past experiences of university technology transfer offices.

The experiences of MUS universities engaged in technology transfer activities suggest these timeframes should be altered to reflect the realities of what is often a complex and time-consuming process. By working with university TTOs, the board should be able to identify meaningful timeframes for invention disclosures and patenting activities. Where these timeframes are based on the actual

Chapter V – Technology Transfer Functions

experiences of universities, they should serve as a more reliable means of assessing the timeliness of the technology transfer process.

Recommendation #6

We recommend the Board of Regents revise timeframes for technology transfer processes outlined in policy number 401.2.

Capitalization of Intellectual Property Assets

Intellectual property (IP) in the form of patents, copyrights, and other protections can have considerable value to organizations. For universities engaged in technology transfer activities, assigning value to these types of property as intangible assets is a relatively recent accounting challenge. Review of university procedures showed UM and MSU have independently developed guidance/policies to use in determining the accounting treatment of IP as intangible assets. UM is currently in the process of developing specific guidance addressing the capitalization procedures for IP assets. MSU refers to a general policy covering all capital assets, without specific guidance on treatment of IP assets.

Montana's universities have not had significant levels of experience in recording IP assets and this probably accounts for the lack of an established and standardized approach to accounting treatments. Currently, there is only one licensing agreement capitalized as an IP asset by MSU. However, as research activities, disclosure of inventions, patent acquisition and licensing agreements continue to increase, there is a potential for MUS universities to acquire IP assets with significant value.

IP assets held by units of the university system have the potential to deliver revenues to universities through licensing agreements and other forms of commercial development. Misstatements in financial reporting could occur where there is no established and standardized methodology for capitalizing these assets. The Office of the Commissioner of Higher Education should work with universities to review and refine methodologies for capitalizing IP as intangible assets. This review should draw on appropriate guidance available

Chapter V – Technology Transfer Functions

from the Department of Administration and ongoing work by the Government Accounting Standards Board.

Recommendation #7

We recommend Board of Regents through the Office of the Commissioner of Higher Education work with universities to review and refine methodologies for capitalizing intellectual property as intangible assets.

Visibility and Awareness of Technology Transfer Functions

Another area where we identified concerns relating to technology transfer functions was the level of awareness among university faculty and staff regarding IP and related issues. Under the Bayh-Dole Act and associated federal regulations, universities and others conducting federally-funded research have a responsibility to ensure provisions of the act are being applied effectively. Provisions of the act include those requiring disclosure of inventions and patenting procedures for universities and others performing federally-funded research. MUS universities are responsible for ensuring faculty and staff performing federally-funded research have at least an awareness of their responsibilities under applicable federal laws.

Survey Responses Showed Low Awareness of Technology Transfer Issues

Survey responses showed generally low levels of awareness among MUS faculty and staff of technology transfer functions and issues relating to IP. The following examples are drawn from survey returns:

- ▶ Nearly half of all principal investigators responding to the survey indicated they did not know whether they had been given an opportunity to attend training addressing IP issues.
- ▶ Only 20 percent of respondents described their knowledge of technology transfer functions as good or very good. One quarter of respondents said they had no knowledge of these functions.
- ▶ Approximately 50 percent of respondents indicated they had either not received guidance addressing conflict of interest in research and technology transfer activities, or were not aware if such guidance had been provided.

The requirements of federal law include reporting of invention disclosures and the potential for commercial development through patenting, which could be adversely impacted if principal investigators are not aware of their reporting responsibilities.

Addressing Training Provision Could Improve Awareness of Technology Transfer Functions

Discussions with MUS management personnel responsible for technology transfer functions indicate information on technology transfer issues is included in general PI training sessions, but faculty/staff may not become aware of this information due to non-attendance at training or a lack of interest in these aspects of the administration of federal awards. Regardless of the level of interest shown by faculty and staff relative to technology transfer, these issues need to be directly and specifically addressed in mandatory training sessions. In addition, university technology transfer functions should develop in-depth training content in this area and make efforts to publicize these training opportunities and promote attendance. Modifications in training provision relating to technology transfer should be made in conjunction with changes discussed in Chapter IV, Recommendation #5, which addressed the need for mandatory training attendance and subject-specific optional training provision for principal investigators.

Recommendation #8

We recommend units of the Montana University System ensure technology transfer issues receive sufficient emphasis in training provision by:

- A. Including direct and specific information on technology transfer issues in mandatory training for principal investigators; and**
- B. Developing subject specific optional training content on technology transfer issues.**

Strategic Prioritization of Technology Transfer

For MUS universities, technology transfer can be described as an emerging opportunity and responsibility. The trends evident in levels of activity support the view that Montana's universities are in

Chapter V – Technology Transfer Functions

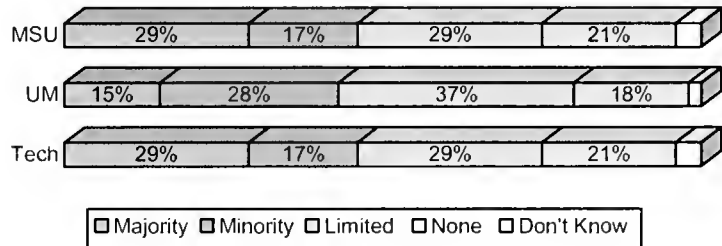
the early stages of developing significant technology transfer operations. The final part of our review of MUS technology transfer functions related to the outcomes achieved and how these compared with any strategic priorities established by different universities.

Survey Responses Show a Disconnect Between Technology Transfer Potential and Prioritization

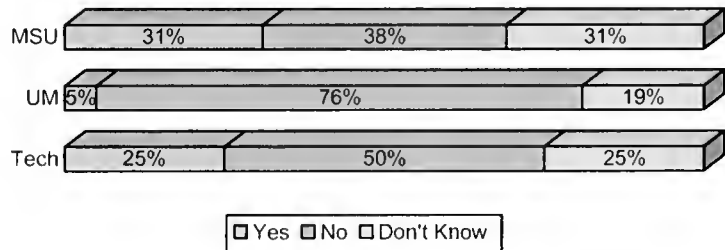
We included questions relating to the performance of technology transfer functions in our survey of PIs. The following figure shows response rates for different MUS universities to two questions relating to the potential for commercialization of research and the resources available to university technology transfer functions.

Figure 12
Survey Responses Relating to Technology Transfer Functions

Question - what proportion of your research has the potential to result in commercially viable ideas, process, technologies or products?



Question - Based on your experience, are there sufficient staff and other resources within your university to ensure intellectual property is protected to the maximum extent possible?



Source: Compiled by the Legislative Audit Division from survey response data.

Chapter V – Technology Transfer Functions

From the perspective of the faculty and staff actually involved in conducting research, these responses appear to illustrate two broad issues relating to technology transfer functions:

- ▶ The potential for commercialization of research is not restricted to a few niche researchers working in specific fields. For the majority of MUS researchers, there appears broad acceptance of the potential for commercialization of research, indicating a potentially large source of supply for technology transfer projects.
- ▶ MUS research staff and faculty do not believe sufficient resources exist within their universities to protect IP developed as a result of research.

There is an apparent disconnect between the potential for technology transfer activities in Montana's universities and the prioritization of these activities by management. Both the large inflows of research funding and the views of research faculty appear to support assigning technology transfer as a strategic priority for universities. However, in relation to the levels of available resources, there is a perception that technology transfer functions have not actually received the necessary prioritization.

Conclusion

Resources directed towards technology transfer in Montana's universities have not been consistent with the strategic significance of these activities.

Disparities in Technology Transfer Outcomes

There is no clear picture for the MUS as a whole regarding the strategic direction of technology transfer functions. The effects of this strategic drift can be seen in the disparities between different institutions in terms of technology transfer outcomes. As an example, the following table shows data from both UM and MSU for license royalty income received between FY2000 and FY2006.

Table 3
License Royalty Income of UM and MSU
Fiscal Year 2000-Fiscal Year 2006

<u>Fiscal Year</u>	<u>UM Royalties</u>	<u>MSU Royalties</u>
2000	\$55,071	\$109,334
2001	\$37,366	\$110,000
2002	\$11,537	\$174,693
2003	\$1,671	\$65,192
2004	\$2,289	\$65,089
2005	\$1,944	\$101,748
2006	\$1,898	\$103,256

Source: Compiled by the Legislative Audit Division from University records.

The trend in royalty income over the six-year period has been either declining or static. This stands in contrast with rising levels of research funding, and an increase in the number of patents and license agreements held by Montana's universities. At the national level, AUTM data shows a steady increase in the average annual net income per license from around \$40,000 in 1992 to around \$50,000 in 2004. Comparisons with raw data at the national level should be treated with care; it would be unrealistic to expect Montana's universities to have already attained parity with larger research universities in other parts of the country. However, it is not unrealistic to expect license royalty income in Montana's universities to reflect the general upwards trend at the national level.

Role of the Board of Regents in Prioritization of Technology Transfer Functions

The Bayh-Dole Act was enacted to allow universities to obtain title to inventions developed with federal funds, and assigns universities with responsibility for patenting, marketing, and licensing intellectual property developed through research. While individual units of the MUS have responsibilities under Bayh-Dole, the BOR is charged in state law with responsibility for administering the different units as a university system.

Chapter V – Technology Transfer Functions

With regard to technology transfer activities, there is little evidence to support the assertion that the BOR has discharged its responsibility to administer the system as a single university. Component units have not been required to prioritize technology transfer activities as defined in Bayh-Dole as strategic priorities. In addition, individual units have not been required to develop objective and comparable means of measuring their successes in the area of technology transfer. MSU's five-year vision statement includes goals related to research and technology transfer activities, but UM has not prioritized technology transfer in its strategic plan or included quantifiable technology transfer goals. Currently, Montana lacks a comprehensive and consistent means of quantifying technology transfer activities across all the units of the MUS. Examples of a more comprehensive and consistent approach can be identified in many other comparable institutions around the country and in national organizations such as AUTM, which regularly compiles consistent and reliable outcomes-based performance measures.

Improvements in MUS Strategic Prioritization of Technology Transfer

Improvements are needed in the ability of the MUS to plan strategically for technology transfer activities and assess its progress in meeting established goals for all component units. These improvements should involve the requirement that universities incorporate the prioritization of technology transfer activities in their strategic planning or similar long-range planning initiatives. The BOR should also work with universities to develop standardized, objective criteria for measuring progress in meeting technology transfer goals. This should involve the identification of suitable outcomes-based performance measures and a process for benchmarking the progress of Montana's universities against comparable institutions around the country.

Chapter V – Technology Transfer Functions

Recommendation #9

We recommend the Board of Regents develop a system-wide approach to technology transfer issues by:

- A. Requiring universities to incorporate technology transfer functions in long-range planning initiatives; and**
- B. Developing standardized means of assessing progress in meeting technology transfer goals.**

Role of Universities in Technology Transfer

Provisions of the Bayh-Dole Act relating to technology transfer have had a fundamental impact on how universities address issues relating to intellectual property and commercialization of academic research. Technology transfer is no longer an optional activity for institutions where certain faculty members were prepared to take an active interest in commercialization. It is a federally-mandated extension of universities' research mission. Montana's universities have adapted to these new realities by establishing and continuing to develop technology transfer capacities. The improvements suggested in this chapter should help universities plan for future growth in this area and further develop the ability of the MUS to fully capitalize on the opportunities presented by technology transfer.

According to the National Governor's Association, in knowledge-driven modern economies, the importance of universities as centers of excellence in both educational and entrepreneurial activity has been increasing. For Montana's universities, as with other world-class research institutions, the traditional educational role has inevitably been supplemented with a new role as creators and facilitators of commercially viable technologies. The economic impact of this new role for universities is receiving increasing attention and is the subject of the final chapter of this report.

Chapter VI - Economic Impact of Research and Development

Introduction

This chapter discusses the economic impacts of MUS universities research and development (R&D) activities. R&D is becoming more pronounced throughout the nation's universities. Some universities emphasize the conduct of research as its primary mission, including the training of undergraduate and graduate students, and the transfer of technology. Research not only has the opportunity to lead to technology transfer, but also to new income opportunities to further research and education, new jobs, and offers Montana businesses the opportunity to license technology and use equipment, which otherwise would be unavailable.

Audit work relating to the economic impact of R&D included assessment of the following issues:

- ▶ Incentives available to MUS faculty and staff participating in R&D activities.
- ▶ Direct benefits to MUS staff, faculty and students from R&D activities.
- ▶ MUS cooperation with private sector businesses.

Incentives Available to MUS Faculty

University staff and faculty have the opportunity to receive incentives through technology transfer. Establishing and maintaining these incentives at the right level is a necessary first step in ensuring technology transfer can have some kind of economic impact. In Montana, the framework of incentives for technology transfer activities is established in state law and Board of Regents (BOR) policy.

State Law and Board Policy Allows for Technology Transfer Activities

Statutory provisions in Montana allow university employees to participate in technology transfer activities with the prior approval of the BOR. State law was amended in 2001 to allow university employees to benefit from employment or ownership interests in businesses commercializing intellectual property developed as a result of R&D activities. These revisions to state law established the principle that university employees could benefit personally from

Chapter VI - Economic Impact of Research and Development

their creative works and allowed the MUS to develop an incentive program to further encourage these activities among staff and faculty.

MUS universities are required by the BOR Policy Section 401.2 to provide the inventor on an annual basis 50 percent of all net royalties and other income received by the university. The remaining 50 percent is distributed according to university policy. UM currently distributes net royalty revenue by providing 50 percent to the inventor, 25 percent to the unit the inventor works under, and 25 percent to the VPRD office. MSU currently deducts a development fee and direct patent costs from licensing revenues and then shares the net revenues evenly between the inventors and the Office of the Vice President for Research, Creativity, and Technology Transfer. The following table shows Montana universities and selected peer institutions percentage of royalties which are provided to the inventor.

Table 4
Percentage of Net Royalties the Inventor Receives

<u>Institution Name</u>	<u>Percentage of Net Royalties</u>
University of Nevada – Las Vegas	60%
University of Wyoming	60%
<i>Montana University System</i>	<i>50%</i>
South Dakota State University	50%
University of Alaska - Fairbanks	50%
North Carolina State University	40%
University of Idaho	40%
Purdue University	33%
Colorado State University	30%
North Dakota State University	30%
Average Rate	45%

Source: Compiled by the Legislative Audit Division from MUS and peer institution records.

Chapter VI - Economic Impact of Research and Development

With the average percentage being 45 percent, MUS universities appear to be providing inventors with comparable incentives when compared to selected peer institutions. Survey responses from MUS staff and faculty indicate only 10 percent of respondents did not think the current royalty splits offered sufficient incentives for the disclosure of intellectual property.

Faculty Tenure and Promotion

Another area where university policies can impact the incentives for R&D activities is with faculty tenure and promotion decisions. According to BOR policy, faculty tenure policies at MUS universities are decided at the campus level and generally reside within a specific academic unit in which the faculty member is employed. UM-Missoula includes tenure requirements as part of the collective bargaining agreement. However, individual departments, while guided by the standards and procedures in the collective bargaining agreement, are allowed to make additions to the policy as long as they are consistent with those in the agreement. MSU-Bozeman also allows the department to draw up their own tenure requirements; however, these should align with university-wide standards for tenure located in university policy.

When surveying faculty members at MUS universities, we asked whether their university policy on faculty tenure and promotion gives appropriate recognition to development of intellectual property opposed to publication of research. For the MUS as a whole, 40 percent of principal investigators responded negatively to this question, indicating they were not satisfied development of intellectual property was given appropriate recognition in tenure and promotion decisions.

Conclusion

State law and Board of Regents policy provide appropriate incentives intellectual property activities, but some staff and faculty have concerns over the level of recognition given to these activities in tenure and promotion decisions.

Chapter VI - Economic Impact of Research and Development

Benefits to MUS Employees and Students

Sponsored research funded through external sources provides resources to Montana's universities both directly and indirectly. Universities benefit directly from research funding used to support staff and faculty positions, and invest in research equipment and facilities. Indirect benefits can be seen in the educational and employment opportunities sponsored research can provide for undergraduate and postgraduate students attending Montana's universities.

Direct Support

The most significant direct impact on universities from sponsored research funding is in the form of salaries and benefits for MUS staff and faculty. According to MSU expenditures for FY 2005, approximately two-thirds of total expenditures or \$66 million, was expended for salaries. A report prepared by the MUS in 2002, stated UM expended approximately 65 percent of research dollars to support staff salaries and benefits. With this taken into consideration, research activities on MUS universities could be considered one of the state's leading employers.

Graduate and Undergraduate Research Activities at MUS Universities

Research advances the knowledge and training for future generations of researchers and teachers. We obtained information through our survey of faculty at universities related to the impact research has on students. The following figure represents the responses we received.

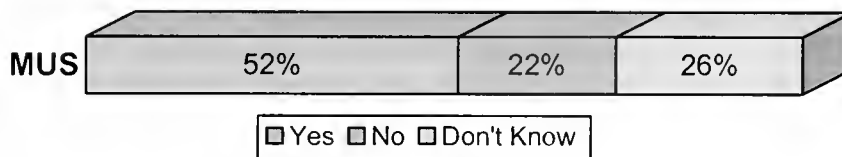
Figure 13

Survey Responses Relating to Impacts of Research Activities

Sponsored research provides opportunities for students to benefit from participation in research projects access to equipment/facilities or other resources which may not otherwise have been available.



Have any of your former students or students in your department been able to benefit from employment opportunities as a result of technology transfer activities or collaboration with the private sector?



Source: Compiled by the Legislative Audit Division from survey response data.

According to survey responses, close to 90 percent of faculty believe research provides opportunities for students to benefit from participation in research projects, access to equipment and facilities, or other resources, which may not otherwise have been available.

We also asked if students had been able to benefit from employment opportunities as a result of R&D activities. As shown, around half of survey respondents indicated students had been able to benefit from employment opportunities as a result of R&D activities.

Survey responses indicate university faculty and staff involved in sponsored research projects see a clear benefit to students from these activities. These responses also highlight the level to which research activities on campuses have become interlinked with universities traditional educational mission.

Chapter VI - Economic Impact of Research and Development

MUS Links with the Private Sector

R&D allows Montana businesses the opportunity to gain access to technology and equipment, which may otherwise be unavailable. When looking at MSU data from 2002, it reported working with more than 60 Montana companies, which ranged from student internships, joint university/industry research projects, and utilization of university facilities and equipment. Currently the university has 110 license agreements; 67 of these are with Montana companies. UM currently has seven license agreements, six with companies in or who have operations in Montana.

MUS universities also allow businesses to use equipment and facilities, if requested. However, under federal policy, it is required the universities charge businesses the going market rate for the use of its equipment and/or facilities.

Other Assistance Offered to Montana Businesses

Although, MUS universities are significant contributors to the growth of the state's technology economy, other programs with close links to the university, are also contributors. These programs are listed below with a brief narrative describing why they were created.

Bozeman

- ▶ TechLink Center was created to link companies with federal laboratories for technology licensing, research, and technology transfer. Currently it helps the Department of Defense and NASA commercialize leading-edge new technology.
- ▶ TechRanch was created to assist Montana-based research institutions with their quest to commercialize research.
- ▶ The Montana Manufacturing Extension Center (MMEC) is a statewide manufacturing outreach and assistance center. It was created to improve the competitiveness of Montana manufacturers through engineering and managerial assistance.
- ▶ The Montana Agricultural Experiment Stations and the Extension Service network offer Montana producers state-of-the-art technologies and solutions to agricultural problems facing the state.
- ▶ Advanced Technology Park provides business space and building sites for research.

Chapter VI - Economic Impact of Research and Development

Missoula

- ▶ The Montana Technology Enterprise Center (MonTEC) was formed to house technology-based businesses created from UM intellectual properties.
- ▶ The Montana World Trade Center assists businesses seeking to expand into international trade and develop their export potential.
- ▶ The Montana Forest and Conservation Experiment Station pursues a wide variety of research and development efforts supported by many different partners.
- ▶ The Flathead Lake Biological Station is an ecological research and education center.

Butte

- ▶ The Montana Bureau of Mines and Geology has been mandated to conduct research and assist in the orderly development of the state's mineral and water resources.

Research and Development and Montana's Economy

Montana's universities have developed strong links with local businesses and continue to make efforts to transfer technology through various means to the private sector. It is difficult to make any direct assessment of the extent of these activities or directly quantify economic impacts. Many of the economic benefits of university research are not in the form of licensing agreements or direct assistance or cooperation between campuses and private businesses, but informal contacts and relationships that develop over time. Montana's universities appear to be implementing the intent of federal law with regard to contacts with the private sector and mechanisms for transferring technology. As the universities continue to develop their sponsored research activities and technology transfer capacities, it should be expected that their impact on the state's economy will grow.

Appendix A - Scope and Methodologies

Audit Scope

To establish audit scope, we initially relied on the guidance provided in the performance audit priority narrative reviewed by the Legislative Audit Committee for the 2005 biennium. The audit priority narrative addressed assessment of Montana University System (MUS) management of research and development (R&D) programs, including technology transfer. The narrative also discussed the assessment of the economic benefits of these activities and MUS campuses competitive position versus other states. We also reviewed state and federal statutes, Board of Regents (BOR) policy, university policy, and other materials related to R&D and technology transfer.

Audit scope was limited to the three main research campuses within MUS. These including Montana State University-Bozeman (MSU), Montana Tech of The University of Montana (Tech), and The University of Montana-Missoula (UM).

Audit Methodologies

In response to audit objectives, we developed methodologies outlined in the following sections.

Audit Planning

We obtained and reviewed federal statutes related to the administration of grants and contracts and regulations related to universities transfer of technology to the private sector. Montana statutes were also reviewed related to MUS R&D and technology transfer activities. We reviewed multiple sources of budget information related to R&D including university, national, and agency records. Interviews were conducted with the Vice President for Research and Development and their staff at each university to discuss their organization and administration, management controls, information systems, and general policy and procedures in relation to the administration of grants and contracts and the transfer of technology to the private sector. Audits and other reports from the various sources including the Association of University Technology Managers (AUTM), federal agencies, and our office were reviewed to identify issues relevant to university R&D and technology transfer programs.

Appendix A - Scope and Methodologies

University R & D and Technology Transfer Program

We interviewed department staff within the Office of Sponsored Programs and Technology Transfer Offices at each university. We reviewed federal and state statutes related to grant administration and technology transfer activities, BOR policy, and university policy. Interviews were conducted to identify the roles and responsibilities in relation to R&D in the different offices. Faculty was also interviewed at each campus to identify any concerns with how their university was handling R&D and technology transfer activities or any comments related to R&D and technology transfer.

We also reviewed the procedures for documentation related to grant administration and technology transfer at each office. This review included examining forms, file contents, and information systems. We identified and reviewed grant files at each university for a total of 26 randomly selected files to determine whether MUS campuses were complying with federal and state statutes and university policy and procedures. Licensing agreements, patent documentation, and other technology transfer documents were also reviewed to identify whether MUS campuses comply with federal and state statutes.

Through interviews and obtaining various reports from the universities, we were able to identify the level of R&D dollars awarded and expended and the level of technology transfer activities for each MUS campus.

Economic Trends in R & D and Technology Transfer

In order to obtain data related to trends in research we reviewed national research and development databases. These included the National Science Foundation's WebCASPR and RAND's Research and Development in the United States (RaDiUS) databases. We also looked at various reports from the universities, the Office of the Commissioner of Higher Education (OCHE), and national reports to identify trends in research and technology transfer. Interviews were conducted with various centers and programs related to the university included MonTEC, TechLink, and the Montana Manufacturing Center.

Appendix A - Scope and Methodologies

Comparison of Other Institutions

Each objective included methodologies addressing a comparative analysis of R&D and technology transfer activities for other peer institutions around the nation. In order to identify peer institutions we first identified states around the nation, which were considered part of the National Science Foundation's (NSF) Experimental Program to Stimulate Competitive Research (EPSCoR). Idaho, Wyoming, and Alaska were selected from this list due to geographic location, lack of medical schools, and level of R&D funding received from federal agencies. Institutions selected from these states included the University of Idaho, University of Wyoming, and the University of Alaska-Fairbanks.

In order to identify the remaining seven institutions, we selected institutions based on the following criteria: members of the National Association of State Universities Land-Grant Colleges (NASULGC), universities with similar levels of R&D funds received from federal agencies, geographic location, and no medical school. These institutions included Tuskegee University (Alabama), South Dakota State University, North Dakota State University, and the University of Nevada-Las Vegas.

The other institutions selected received considerably more R&D funds from federal agencies than MUS campuses and were not geographically located. However, these are examples of institutions MUS campuses have to compete with in order to receive R&D funds from federal agencies. None of these institutions have medical schools. These institutions included Colorado State University, North Carolina State University, and Purdue University (Indiana).

Our comparative analysis included looking at all institutions level of R&D expenditures, technology transfer activities, training procedures, congressional appropriation procedures, enrollment numbers, and other areas related to their R&D programs. Information collected for these institutions, was also collected for the MUS campuses in order to compare institutions.

Appendix A - Scope and Methodologies

Survey of Faculty

Each objective also included methodologies addressing a survey of faculty members at each MUS campus. Faculty members, currently assigned as principal investigators, were invited to participate in the survey. Survey responses were used to help identify areas for improvement in university operations, and in state law and Board of Regents policies.

Survey questions addressed multiple issues, including administration of research grants, services provided by the Office of Research/Sponsored Programs, intellectual property protection, technology transfer practices, and the general role of sponsored research in higher education. The following section provides MUS faculty responses by question.

Appendix B

Appendix B

Survey Questions Relating to Office of Research/Sponsored Programs Services

Question Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
The office of the VP for Research provides accurate and timely notification of grant funding opportunities from federal state and local governments and private industry.	25%	53%	12%	2%	8%
The Office of Research/Sponsored Programs provides relevant training for faculty on submission of proposals for sponsored research.	19%	57%	12%	3%	8%
The Office of Research/Sponsored Programs is responsive to questions and requests for assistance as research projects are in progress.	38%	45%	7%	1%	8%

How would you assess the quality of advice/guidance provided by the Office of Research/Sponsored Programs in relation to the following aspects of grant administration for sponsored research?						
	Very Good	Good	Average	Poor	Very Poor	N/A
General Budgeting Procedures	38%	31%	20%	5%	1%	5%
Allowable/Unallowable Costs	32%	35%	22%	3%	1%	7%
Sub-Contracting	20%	31%	21%	5%	2%	21%
Documentation of Expenditures	24%	33%	24%	6%	3%	9%
Federal Reporting Requirements	22%	28%	27%	5%	2%	15%

Appendix B

Question Statement	Yes	No	Don't Know
Have any research proposals you have submitted through the university been delayed or turned-down due to a lack of matching funding?	14%	86%	NA
Grant proposals include budgeted indirect cost rates or facilities and administration rates applied as a proportion of direct costs. Do you have a clear understanding of the process used to calculate these rates in the grant budgeting process?	72%	23%	5%

Appendix C

Appendix C

Survey Questions Relating to Intellectual Property and Technology Transfer

Question Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
University policies allow faculty to maintain an appropriate balance between teaching responsibilities and conducting sponsored research.	10%	43%	21%	11%	15%
Sponsored research provides opportunities for students to benefit from participation in research projects access to equipment/facilities or other resources which may not otherwise have been available.	53%	36%	3%	1%	7%

	Majority	Minority	Limited	None	Don't Know
Approximately what proportion of your research has potential to result in commercially viable ideas processes technologies or products?	18%	27%	34%	18%	3%

How would you describe your knowledge of the following laws/policies governing the protection of intellectual property developed as a result of sponsored research in universities?					
	Very Good	Good	Basic	None	Don't Know
Federal Laws	8%	18%	45%	19%	10%
State Laws	4%	11%	45%	28%	11%
Board of Regents Policies	4%	13%	39%	32%	12%
University Policies	10%	26%	41%	15%	8%

Appendix C

Question Statement	Yes	No	Don't Know
Within the past 12 months has the university given you the opportunity to attend training sessions which included information on intellectual property issues?	35%	17%	47%
Do you think your university's policies on faculty tenure and promotion give appropriate recognition to development of intellectual property (patenting and other protections) as opposed to publication of research?	60%	40%	NA
Has the university provided you with specific guidance addressing disclosure of conflicts of interest in relation to sponsored research or technology transfer activities?	48%	24%	29%
Montana law and Board of Regents policy currently allow university staff to retain 50% of net income resulting from commercialization of intellectual property. State law and board policies also allow university staff to hold equity interests or be compensated by businesses developing the intellectual property. Do current policies provide a sufficient incentive for faculty to disclose intellectual property developed through sponsored research?	49%	9%	42%

Appendix D

Appendix D Survey Questions Relating to the Patent Process

Question Statement	Yes	No	Don't Know
Have you ever submitted an invention disclosure which you believe was not given adequate consideration for patenting or other intellectual property protection?	21%	79%	NA
Are you satisfied that the technology transfer office processes invention disclosures and patent applications in a timely manner?	74%	26%	NA
During the patent application process did you have access to legal counsel from an attorney experienced in patent law?	56%	44%	NA
From your point of view did the lack of access to legal counsel cause any problems with the patenting process?	32%	68%	NA
From your point of view was the patenting process improved by having access to legal counsel?	89%	11%	NA
Based on your experience are there sufficient staff and other resources available within your university to ensure intellectual property is protected to the maximum extent possible?	23%	49%	27%

Appendix D

	Within the past 6 months	Within the past 12 months	Within the past 1 to 5 years	More than 5 years ago	Never
When was the last time your university's technology transfer office asked you about the potential for disclosing inventions or commercializing technologies developed through your research?	33%	17%	13%	7%	29%

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Don't Know
Overall were you satisfied the technology transfer office made sufficient efforts to keep you informed of major developments in the patenting process?	7%	34%	35%	15%	4%	5%

Appendix E

Appendix E Survey Questions Relating to the Patent Process

	Yes	No	Don't Know
Do you think Board of Regents and university policies provide enough flexibility to allow for successful collaborations between university staff/faculty and private sector organizations?	52%	28%	21%
Have the individuals or organizations within the private sector you worked with ever expressed frustration with university policies and procedures relating to technology transfer or suggested changes?	59%	41%	NA
Do you think the technology transfer office gives comprehensive consideration to all potential businesses when deciding on licensing agreements for technologies developed in the university?	18%	29%	53%
For the technology transfer activities you were involved with, did the university make use of available resources outside of the VP for Research office (for example, using the business school or affiliated centers and institutions to assist in developing or marketing intellectual property)?	29%	31%	40%
Have any of your former students or students in your department been able to benefit from employment opportunities as a result of technology transfer activities or collaboration with the private sector?	63%	20%	18%

Appendix E

	I contacted the TTO	I contacted a private sector organization directly	The TTO contacted me	A private sector organization contacted me directly	Other
Who was responsible for initiating contacts regarding your involvement in technology transfer activities or collaboration with private sector organizations?	45%	24%	5%	16%	9%

Appendix E

	Very Good	Good	Neutral	Poor	Very Poor	Don't Know
How would you describe your university's efforts to market inventions and other intellectual property to private sector organizations?	6%	32%	19%	26%	11%	6%

	Very Easy	Somewhat Easy	Moderately Difficult	Very Difficult	Don't Know
How would you describe the ease or difficulty involved in establishing spin-off businesses or other small ventures to commercialize university research in the state of Montana?	9%	23%	26%	11%	30%

	Very Significant	Significant	Moderate	Minimal	Negligible	Don't Know
How would you describe the overall impact on Montana's economy of research and development and technology transfer activities within the university system?	32%	30%	18%	13%	5%	2%

	1-2	3-5	6-10	11-20	20+
Approximately how many students have benefited from employment opportunities resulting from technology transfer activities or collaboration with the private sector?	18%	29%	32%	6%	15%

University Response



MONTANA UNIVERSITY SYSTEM
Office of the Commissioner of Higher Education

46 N Last Chance Gulch ♦ PO Box 203201 ♦ Helena, Montana 59620-3201
(406)444-6570 ♦ FAX (406)444-1469

November 6, 2006

Scott A. Seacat
Legislative Auditor
Legislative Audit Division
P.O. Box 201705
Helena, MT 59620-1705

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LEGISLATIVE AUDIT DIV.

Dear Mr. Seacat,

I have enclosed the official response from the Montana Board of Regents, concerning the Research and Development Performance Audit that was conducted this past year.

I and my staff concur with all of the recommendations. I, members of the Board, and the staff at our research campuses have also asked me to convey their appreciation for the hard work and professionalism of your staff in developing these recommendations. Members of your staff visited with the research and technology transfer staffs of our research universities numerous times in order to understand the complex issues surrounding research funding and technology transfer operations.

The recommendations of this performance audit will assist the Montana University System in developing or revising policies that will improve the Board of Regent's understanding of the myriad research and technology transfer activities on our campuses. The recommendations will also lead to improved communications between faculty and staff at our research campuses and should expand the commercialization of our world-class research by Montana companies.

Best regards,

A handwritten signature in cursive script that reads "Sheila M. Stearns".

Sheila M. Stearns
Commissioner of Higher Education

cc: The Board of Regents

**MONTANA BOARD OF REGENTS OF HIGHER EDUCATION
MONTANA UNIVERSITY SYSTEM
RESPONSE TO RESEARCH AND DEVELOPMENT PERFORMANCE AUDIT
November 6, 2006**

This document represents the Commissioner of Higher Education's response to the performance audit report, dated November 2006, concerning research and development activities of the Montana University System. The Commissioner and her staff concur with the recommendations set forth in the audit and have set forth a timeline for working with the Board of Regents and our campuses to comply with the recommendations.

Recommendation #1

We recommend the Board of Regents ensure consistent reporting of data relating to research activities on campuses.

Response: Concur. In July 2006 The Board of Regents approved a strategic plan that sets strategic goals for research and commercialization activities. The Commissioner's Office will work with the Regents and our research campuses to develop more consistent and detailed data reporting requirements which can be better used to measure progress toward our strategic objectives. Target completion: July 2007.

Recommendation #2

We recommend the Board of Regents, through the Office of the Commissioner of Higher Education, coordinates the use of information systems within research administration functions.

Response: Concur. The Commissioner's Office will work with the research campuses to ensure that information systems for research administration are secure and produce consistent data for the Board of Regents. Target completion: September 2007.

Recommendation #3

We recommend The University of Montana – Missoula assign pre-award staff within the Office of Sponsored Programs by departmental specialization.

Response: Concur. The Commissioner's Office will support UM-Missoula in a review of the structure and workload in their Office of Sponsored Programs and support staff changes needed to deal with increased administrative requirements. Target completion: March 2007.

Recommendation #4

We recommend Montana University System universities:

A. Develop and implement mandatory training content addressing core elements in research; and

B. Provide faculty and staff with additional training opportunities as needed, related to specific subjects relevant to different aspects of the administration and management of research programs.

Response: Concur. The Commissioner's Office will support the research campuses in implementing this recommendation. Target completion: all training will be implemented by the end of FY 2008.

Recommendation #5

We recommend the Montana Board of Regents address its role in the process of direct congressional appropriations by:

A. Identifying information relevant to earmark funding to be compiled by universities: and

B. Becoming more involved in the understanding and review of these funding sources.

Response: Concur. The Commissioner's Office will ensure the Board of Regents has an opportunity to review and better understand congressional earmark requests. The Commissioner's Office will ensure the Board is apprised of federal appropriations for 2007, which are already underway, and fully implement revised and comprehensive procedures for review in FY 2008.

Recommendation #6

We recommend the Board of Regents revise timeframes for technology transfer processes outlined in policy number 401.2.

Response: Concur. The Commissioner's Office will present the Board of Regents with a recommended policy revision no later than the March 2007 meeting of the Board.

Recommendation #7

We recommend the Board of Regents through the Office of the Commissioner of Higher Education work with universities to review and

refine methodologies for capitalizing intellectual property as intangible assets.

Response: Concur. The Commissioner's Office will work with the research campuses to implement consistent accounting methodologies for capitalizing intellectual property. In December 2006, the Government Accounting Standards Board (GASB) is widely expected to issue rules for capitalizing intellectual property at university campuses. If these rules are adequate and comprehensive, the Commissioner's Office will ensure they are implemented. If further refinement for the Montana University System is needed, the Commissioner's Office will ensure they are developed. Target completion: June 2007.

Recommendation #8

We recommend units of the Montana University System ensure technology transfer issues receive sufficient emphasis in training provision by:

A. Including direct and specific information on technology transfer issues in mandatory training for principal investigators; and

B. Developing subject specific optional training content on technology transfer issues.

Response: Concur. The Commissioner's Office will support the research campuses in implementing this recommendation. Target completion: September 2007.

Recommendation #9

We recommend the Board of Regents develop a system-wide approach to technology transfer issues by:

A. Requiring universities to incorporate technology transfer functions in long-range planning initiatives; and

B. Developing standardized means of assessing progress in meeting technology transfer goals.

Response: Concur. Consistent with the implementation of Recommendation #1 and the Board of Regent's Strategic Plan, the Commissioner's Office will make recommendations to the Board of Regents to refine and implement this recommendation at each research campus in the Montana University System. Target completion: September 2007.

November 8, 2006

Mr. Scott A Seacat
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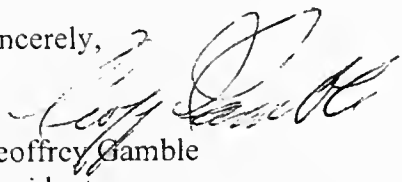
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NOV 08 2006
LEGISLATIVE AUDIT DIV.

Dear Mr. Seacat:

Montana State University appreciates the time and effort your auditors devoted to the recent performance audit of Research and Development. MSU supports the Commissioner of Higher Education in assisting the Montana University System in developing and revising policies that will improve the Board of Regent's understanding of the research and technology transfer activities. Enclosed are detailed responses specific to MSU for the audit recommendations. For example, with regard to recommendation four, MSU implemented mandatory training in 2004 and more than 800 people have attended that training.

We appreciate the cooperative efforts made by the audit team and thank those involved for their assistance. We will continue to make improvements and strive for precision in our processes.

Sincerely,


Geoffrey Gamble
President

GG/sm

cc: Commissioner Sheila Stearns

Office of the President

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Montana State University

Response to Legislative Audit Division Performance Audit – MUS Research and Development

RECOMMENDATION #1

We recommend the Board of Regents ensure consistent reporting of data relating to research activities on MUS campuses.

Montana State University concurs with the recommendation and will work with the Board of Regents (BOR), Office of the Commissioner of Higher Education (OCHE) and Montana University System (MUS) personnel to establish standardized research data reporting. Definitions and criteria will be developed by 1 July 2007 with reporting to the BOR/OCHE fall 2007.

RECOMMENDATION #2

We recommend the Board of Regents through the Office of the Commissioner of Higher Education coordinate the use of information systems within research administration functions.

Montana State University concurs with the recommendation. Once the data from Recommendation #1 above is defined and reporting criteria outlined, Montana State University will ensure the research data is efficiently secured in appropriate information systems.

RECOMMENDATION #3

We recommend The University of Montana – Missoula assign pre-award staff within the Office of Sponsored Programs by departmental specialization.

This recommendation is not applicable to Montana State University.

RECOMMENDATION #4

We recommend Montana University System universities:

- A. Develop and implement mandatory training content addressing core elements in research; and**
- B. Provide faculty and staff with additional training opportunities as needed, related to specifics subjects relevant to different aspects of the administration and management of research programs.**

Montana State University not only concurs with the recommendation but implemented mandatory PI training in 2004. Montana State University has already trained over 800 employees including principal investigators, lab personnel, administrative staff and graduate students. All Montana State University campus personnel who perform research were required to attend prescribed training both for core research elements and specialized training as needed. Montana State University will continue and expand its training programs.

RECOMMENDATION #5

We recommend the Montana Board of Regents address its role in the process of direct congressional appropriations by:

- A. Identifying information relevant to earmark funding to be compiled by universities; and**
- B. Becoming more involved in the understanding and review of these funding sources.**

Montana State University concurs with the recommendation and will work with BOR/OCHE to inform them of proposed congressional appropriation proposals. University personnel will work with OCHE personnel to establish timelines and reporting format. As a point of additional clarification, MSU's federal relations expenditures referenced in Chapter IV serve multiple purposes such as monitoring and reporting on policy initiatives, competitive solicitations, make recommendations for policies, actions et cetera, facilitate meetings with policy makers, identify opportunities where MSU should have input. Only 20% of the contract is for direct assistance in selection and preparation of appropriation requests and preparation of materials for appropriation earmarks and other bill language.

RECOMMENDATION #6

We recommend the Board of Regents revise timeframes for technology transfer processes outlined in policy number 401.2.

Montana State University concurs with the recommendation and will work with OCHE to establish reasonable timeframes for the technology transfer process.

RECOMMENDATION #7

We recommend Board of Regents through the Office of the Commissioner of Higher Education work with universities to review and refine methodologies for capitalizing intellectual property as intangible assets.

Montana State University concurs with the recommendation and will complete capitalization of intellectual property as intangible asset procedures by June 2007.

RECOMMENDATION #8

We recommend units of the Montana University System ensure technology transfer issues receive sufficient emphasis in training provisions by:

- A. Including direct and specific information on technology transfer issues in mandatory training for principal investigators; and**
- B. Develop subject specific optional training content on technology transfer issues.**

Montana State University not only concurs with the recommendation but integrated technology transfer issues into the mandatory training that began in October 2005. University Principal Investigators will continue receive appropriate technology transfer training as part of Recommendation #4. With regard to subpart B of this recommendation, Montana State University offers an informational technology transfer DVD which is provided to faculty upon request. Additionally, Montana State University provides intellectual property training, both through staff and specialized attorneys, several times a year for subject matter. Recent training subjects were Plant Variety Protection, Patenting, new developments in patent law, copyright/software issues, material transfer agreements and other issues related to intellectual property.

RECOMMENDATION #9

We recommend the Board of Regents develop a system-wide approach to technology transfer issues by:

- A. Requiring universities to incorporate technology transfer functions in long-range planning initiatives; and**
- B. Developing standardized means of assessing progress in meeting technology transfer goals.**

Montana State University not only concurs with the recommendation but incorporated technology transfer into its original Five Year Vision established in 2003. (See <http://www.montana.edu/upba/vision/visiondoc.html>.) The Five Year Vision states

We will continue to grow a powerful research/creativity enterprise that spans the range of basic, applied, developmental and commercialized research. MSU-Bozeman will increase its technology transfer enterprise and through these efforts enhance the Montana economy.

Montana State University will collaborate with BOR/OCHE to incorporate appropriate assessment metrics into our technology transfer planning and goals.



The University of
Montana

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6 November 2006

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NOV 08 2006

LEGISLATIVE AUDIT DIV.

Dear Mr. Seacat:

We thank the Legislative Audit staff for their cooperation and effort on the performance audit of Montana University System Research and Development. As usual, we found the audit team proceeded very professionally and cooperative in their work. Audits and audit reports such as these assist us immensely in our effort to assure full accountability and greater understanding of our endeavors.

We concur with all of the recommendations in the report and University personnel will work with Montana University System and Office of Commissioner of Higher Education personnel to implement the recommendations. We believe we can implement the recommendations by the beginning of the next Academic Year.

We appreciate the cooperative efforts of the audit team and thank those involved for their assistance. We will continue to make improvements and strive for accountability and training in all aspects of our operations.

Sincerely,

George M. Dennison,
President

GMD/as
Denlet3351

c: D. Dwyer, Vice President for Research and Economic Development
S. Stearns, Commissioner of Higher Education

The University of Montana

Response to Legislative Audit Division

Performance Audit – MUS Research and Development

RECOMMENDATION #1

We recommend the Board of Regents ensure consistent reporting of data relating to research activities on MUS campuses.

The University of Montana concurs with the recommendation and will work with Board of Regents (BOR), Office of Commissioner of Higher Education (OCHE), and Montana University System (MUS) personnel to establish standardized research data reporting. Definitions and criteria will be developed by 1 July 2007 with reporting to the BOR/OCHE fall 2007.

RECOMMENDATION #2

We recommend the Board of Regents through the Office of the Commissioner of Higher Education coordinate the use of information systems within research administration functions.

The University of Montana concurs with the recommendation. Once the data has been defined and reporting criteria outlined, The University of Montana personnel will ensure the research data is efficiently secured in appropriate information systems.

RECOMMENDATION #3

We recommend The University of Montana – Missoula assign pre-award staff within the Office of Sponsored Programs by departmental specialization.

The University of Montana concurs with the recommendation. ORSP staffing will be departmentally reassigned by 1 March 2007.

RECOMMENDATION #4

We recommend Montana University System universities:

- A. Develop and implement mandatory training content addressing core elements in research; and**
- B. Provide faculty and staff with additional training opportunities as needed, related to specific subjects relevant to different aspects of the administration and management of research programs.**

The University of Montana concurs with the recommendation. All The University of Montana campus personnel who perform research will be required to attend prescribed training both for core research elements and specialized training as needed. The development of the training will occur in fiscal year 2007 with training to be implemented for the 2008 academic year.

RECOMMENDATION #5

We recommend the Montana Board of Regents address its role in the process of direct congressional appropriations by:

- A. Identifying information relevant to earmark funding to be compiled by universities; and**
- B. Becoming more involved in the understanding and review of these funding sources.**

The University of Montana concurs with the recommendation and will work with BOR/OCHE to inform them of proposed congressional appropriation proposals. University personnel will work with OCHE personnel to establish timelines and reporting format.

RECOMMENDATION #6

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The University of Montana concurs with the recommendation and will work with OCHE to establish reasonable timeframes for the technology transfer process.

RECOMMENDATION #7

We recommend Board of Regents through the Office of the Commissioner of Higher Education work with universities to review and refine methodologies for capitalizing intellectual property as intangible assets.

The University of Montana concurs with the recommendation and will complete capitalization of intellectual property as intangible asset procedures by June 2007.

RECOMMENDATION #8

We recommend units of the Montana University System ensure technology transfer issues receive sufficient emphasis in training provisions by:

- A. Including direct and specific information on technology transfer issues in mandatory training for principal investigators; and**
- B. Develop subject specific optional training content on technology transfer issues.**

The University of Montana concurs with the recommendation. University Principal Investigators will receive appropriate technology transfer training as part of Recommendation #4. Training will be developed during the 2007 fiscal year with the training beginning fall 2007.

RECOMMENDATION #9

We recommend the Board of Regents develop a system-wide approach to technology transfer issues by:

- A. Requiring universities to incorporate technology transfer functions in long-range planning initiatives; and**
- B. Developing standardized means of assessing progress in meeting technology transfer goals.**

The University of Montana concurs with the recommendation and will collaborate with BOR/OCHE to incorporate appropriate technology transfer issues in planning and goals.

